CHANGE MANAGEMENT CAPABILITY MATURITY MODEL FOR CONTRACTORS IN THE KUWAITI CONSTRUCTION INDUSTRY

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ABSTRACT

This research aims to improve the implementation of project change management by contractors to secure better outcomes in construction projects. An empirically designed and tested change management capability maturity model was developed to be used as an infrastructure for boosting the change management capabilities for contractors in Kuwait. This research commenced with an extensive literature review to understand project changes and the implementation of project change management by contractors. This literature review was followed by semi-structured interviews with contractors to allow for a deeper understanding of the success criteria of change management. To validate this criteria, a quantitative questionnaire survey took place and indicated 52 change management success criteria from the perspective of contractors in Kuwait. These success criterions (represented by practices and tools) were grouped using the principal component analysis (PCA) technique and assigned weights within their designated groups using the Analytic Hierarchy Process (AHP) and Delphi technique to indicate their relevant significance within a successful change management process. As a result, the Change Management Capability Maturity Model (CMCMM) was constructed to evaluate the contractor's capability to conduct a prosperous change management process according to the previously concluded success criteria. The model was reviewed by domain experts and by conducting several case studies to substantiate its fitness for purpose and practicality. The case studies also showed that CMCMM was effective in indicating the change management process gaps and successfully outlined the pathway of process improvement and Institutionalisation. The research contributes to the body of knowledge related to construction management and capability maturity models in addition to having several practical implications. This contribution is represented by the development of an empirically based capability maturity model that uses a validated and weighted criteria within each stage of project change management process to evaluate the contractor's ability to conduct project change management process. The research also provides a step-by-step user guide to enable the proper usage of CMCMM and enhance the model's degree of usability by new users in the organisation.

Keywords: change management, capability maturity model, contractor, analytic hierarchy process, delphi technique.

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GLOSSARY

AC	Actual Cost
AHP	Analytic Hierarchy Process
ARC	Appraisal Requirements for CMMI
BIM	Building Information Modelling
BOQ	Bill of quantities
BRM3	Business Risk Management Maturity Model
BS	British Standard
CI	Consistency Index
CII	Construction Industry Institute
CIRIA	Construction Industry Research and Information Association
CKMS	Change and Knowledge Management System
CL	Capability Level
CM3	Change Management Maturity Model
CMCMM	Change Management Capability Maturity Model
CMCML	Change Management Capability Maturity Level
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
CMMI-ACQ	Capability Maturity Model Integration - Acquisition
CMMI-DEV	Capability Maturity Model Integration - Development
CMMI-SVC	Capability Maturity Model Integration - Services
CMS	Content Management System
CNT	Continuous Improvement
CP	Change Possibility
CPM	Critical Path Method
CR	Consistency Ratio
CS	Change Scope
CTC	Central Tenders Committee
CV	Coefficient of Variation
DSM	Dependency Structure Matrix
EC	Evaluating Change
ECM	Engineering Change Management

EFQM/BQM	European Foundation for Quality Management/Business Quality Foundation-Business Excellence Model
EIA	Energy Information Administration
EV	Earned Value
EVM	Earned Value Management
FI	Frequency Index
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GG	Generic Goal
GP	Generic Practice
IC	Identifying Change
IM-PMM	Infrastructure Management-Process Maturity Model
IM-PMM	Infrastructure Management-Process Maturity Model
IMC	Implementing and Monitoring Change
ISO	International Organisation for Standardisation
ITPM^3	IT Performance Measurement Maturity Model
KBDSS	Knowledge-Based Decision Support System
KD	Kuwaiti Dinar
KMO	Kaiser-Meyer-Olkin
KNPC	Kuwait National Petroleum Company
KOC	Kuwait Oil Company
KPA	Key Process Area
MDD	SCAMPI Method Definition Document
ML	Maturity Level
MPW	Ministry of Public Works
NHS	National Health Services
OGC	Office of Government Commerce
OPM3	Organisational Project Management Maturity Model
P2MM	PRINCE 2 Maturity Model
P3M3	Portfolio, Program and Project Management Maturity Model
PAHW	Public Authority of Housing Welfare
PC	Principal Component

PCA	Principal Component Analysis
PCC	Promote a Balance Change Culture
PM^2	Project Management Process Maturity Model
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMMM	Program Management Maturity Model
PMOMIM-MCPs	Program Management Organisation Maturity Integrated Model for Mega Construction Programs
PPE	Personal Protective Equipment
PV	Planned Value
QA	Quality Assurance
QC	Quality Control
QS	Quantity Surveyor
RAF	Rank Agreement Factor
RI	Random Consistency Index
RII	Relative Importance Index
RM3	Risk Management Maturity Model
RMC	Risk Management Capability
SCAMPI	Standard CMMI Appraisal Method for Process Improvement
SCRI	Salford Center for Research and Innovation
SD	Systems Dynamics
SEI	Software Engineering Institute
SG	Specific Goal
SI	Significance Index
SP	Specific Practice
SPICE	Standardised Process Improvement for Construction Enterprises
SPICE FM	Structured Process Improvement Framework for Construction Environments - Facilities Management
UK	United Kingdom
VM3	Value Management Maturity Model
WCMP	Web Project-Based Change Management

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CHAPTER 1 - INTRODUCTION

1.1 BACKGROUND AND JUSTIFICATION FOR RESEARCH

The construction industry plays a major role and has a great influence on every nation's economy and society. Improvements in the economy require the initiation of construction projects which convey merits to the wider society (Ive & Grunberg, 2000). Most importantly, the merits of a growing construction industry include the creation of new employment opportunities on a national level (Ofori, 1990).

Recently, Kuwait has been attempting to expand its construction industry to improve the annual Gross Domestic Product (GDP). Kuwait lies on a border with Iraq and Saudi Arabia in addition to having the Persian Gulf to the southeast of the Gulf Cooperation Council (GCC) country. Kuwait has supremacy over nine islands including Bubiyan and Failaka as the most populated islands. Generally, the landscape of Kuwait is resembled by a desert theme with a slight coastal belt to the East side country.

Kuwait had a GDP of USD 184.54 billion and a USD 48,761.24 GDP per capita (International Monetary Fund, 2014) with an actual GDP growth rate of 10.2% (Economic& Commercial Counsellor Kuwait, 2014). A percentage of 12.2% of the total GDP is generated from industries in Kuwait (Economic & Commercial Counsellor Kuwait, 2014) which mainly includes the petroleum, cement and construction material industries.

Kuwait intensely relies on the oil reserves for economic growth as Kuwait owns 8% of the world crude oil reserves (EIA, 2006). Nonetheless, under the recent declination of oil prices, Kuwait is focusing on the growth of other sectors to retain the national GDP and to enable economic expansion. This diversification was observed through the increased focus on empowering the construction industry by enhancing the industry investments in Kuwait (International Monetary Fund, 2014; Jarkas & Radosavljevic, 2012).

The construction industry in Kuwait is the second major sector contributing to the national GDP. Most of the projects are undertaken by the Public Authority of Housing Welfare (PAHW), Kuwait University and the Ministry of Public Work (MPW) according to the Economic & Commercial Counsellor Kuwait (2014). The current value of Kuwait's construction industry is at USD 3.2 billion with an annual growth of 3.6% (Economic& Commercial Counsellor Kuwait, 2014). The Middle East Business Intelligence which was established in 1957 reported that Kuwait is currently planning and executing construction projects with the value of USD 202 billion which indicates the significance and volume of investments incorporated in the construction industry. These investments focus on education, residential, public, healthcare, commercial, hospitality, leisure and mixed used projects in Kuwait (International Monetary Fund, 2014).

Regardless of Kuwait's huge investments, the local construction industry was criticised for its poor growth rate in comparison with other GCC countries, discouraging private investments, facilitating a weak business environment and its prevailing incompetence in the tendering processes offered by the Central Tenders Committee (CTC) as (Economic & Commercial Counsellor Kuwait, 2014).

Additionally, the construction industry has also been criticised for the high rates of project delays, cost overruns, low productivity (Jarkas & Radosavljevic, 2012). Apparently, disruptive project changes was one of the major elements that is causing this insufficient performance (Al Duaij *et al.*, 2007). Project change can originate from a number of factors that can be internal or external to the project (Love *et al.*, 2002). Changes can also originate from the client, contractor, design, material, equipment or labour related triggers (Assaf & Hejji, 2006). Project changes in Kuwait were particularly sourced to unsteady and unclear client requirements, differing site conditions in the actual project setting and the contractor's claims (Al Duaij *et al.*, 2007). These changes could potentially harm the project through causing cost overrun, completion delay, quality degradation, increased errors, increased rework in addition potentially jeopardising the business of the contractor.

As a proposed solution, the Kuwait Society of Engineers (2001) suggested a contract agreement template that enables the client to add or remove project works with the value of 15% of the original contract value or 25% of any particular working package with denying the right of the contractor to object on this requirement. On the other hand, MPW as a client requires that any variation orders that exceed KD 100,000 should be reviewed and approved by Audit Bureau before being admitted to the project including both the addition or omission of works (Al Duaij *et al.*, 2007). Additionally, CTC has to approve the variation orders with values more than 5% of the original contract value.

Clearly efforts have been put in place to solve this issue yet project changes remains unavoidable and still plagues the performance of contractors in Kuwait and impedes the clients' level of satisfaction. It is very important to ensure that contractors are fully equipped with all the tools to manage these changes in the best resilience and adaptability possible. Therefore, the contractors capability to manage changes in the project should be properly evaluated, controlled and improved in Kuwait to assure client satisfaction and adequate project delivery. Managing project changes properly is beneficial for the health and success of the project and also could be potentially value adding to the client when dealing with beneficial changes. Project change management is the application of a structured process to assist the project team in achieving the required project outcomes (Prosci, 2014). Possessing a high capability in project change management would ensure that contractors in Kuwait are capable of handling the changes that emerge in the project.

Based on the current literature, studies concerned with the project change management capability appraisal and improvement are very limited. These studies are rather primitive and do not represent a solid basis for evaluating and potentially improving the change management capability of contractors in Kuwait. As a result, This study focused on developing a Capability Maturity Model (CMM) that evaluates the capability progress level of the contractors in Kuwait and points out the gaps in the current change management process to potentially pave the way for future improvements. The model was tailored based on the most appropriate change management criteria that would be valuable and relevant for contractors in Kuwait and their clients. Having the capacity of adequately managing change will eventually reduce the issues sourced to project changes in the project.

1.2 RESEARCH AIM AND OBJECTIVES

This study is aimed at investigating the problems caused by changes and variations during construction project and developing a model for assessing the change management capability of contractors with specific focus on contractors in Kuwait. The specific research objectives to achieve this aim are:

1. To explore theoretical concepts and previous work on project changes and change management in construction with specific focus on contractors,

2. To evaluate the existing change management practice in Kuwait from the contractors' perspective,

3. To identify key factors that indicate the ability of contractors in handling project change,

4. To develop a Change Management Capability Maturity Model (CMCMM) for assessing the change management position of contractors and their capabilities,

5. To validate and verify the application of CMCMM through using the expert review and case study research methods.

1.3 RESEARCH METHODOLOGY

The research methodology used in this study includes a mixture of an extensive literature review, qualitative and quantitative techniques, model construction, experts review and case study. This combination is used to achieve the research aim and objectives. A detailed discussion of these methods is featured in Chapter 5 of this dissertation yet is briefly shown in this section. Table 1-1 outlines how the different research methods were connected to achieving the research objectives.

Table 1-1 Research methods and objectives correlation

	Literature Review	Semi-Structured Interview	Questionnaire Survey	AHP Panel Review	Domain Experts Review	Case Study
Objective 1: To explore theoretical concepts and previous work on project changes and change management in construction with specific focus on contractors	✓					
Objective 2: To evaluate the existing change management practice in Kuwait from the contractors' perspective	✓	✓				
Objective 3: To identify key factors that indicate the ability of contractors in handling project change	✓	✓	✓			
Objective 4: To develop a Change Management Capability Maturity Model (CMCMM) for assessing the change management position of contractors and their capabilities			✓	✓	✓	✓
Objective 5: To validate and verify the application of CMCMM through using the expert review and case study research methods					✓	✓

The literature review thoroughly investigated changes that may occur in projects within the context of the construction industry. This exploration required looking elaborately into project change dimensions including time, need, effect, process and environment in addition to the association and connectivity of these dimensions. The literature review also discussed the numerous project change causes and its classification. The literature review also discussed the change effects of detrimental, beneficial and neutral changes when encountered in a project. A special emphasis was given to project changes in the Kuwaiti construction industry and the frequent causes and effects of these changes. The literature review also focused on the dimensions of change management including people, process, tools, methodologies and finally results and outcomes. Next, the literature review focused on the mechanism and operation routes of Capability Maturity Models (CMMs). CMMs developed for the change management domain were reviewed to find the gaps in the current body of knowledge. Several gaps were noticed in the existing knowledge when it comes the change management related capability maturity models domain. Therefore, it was deemed necessary to develop a model that would effectively contribute to the enhancement of the change management capability.

In addition to the change management practices recognised through the literature review, the existing change management practices for each change management stage were further explored through conducting preliminary semi-structured interviews with practitioners in the Kuwaiti construction industry. After conducting a qualitative analysis, the interviews contributed to enhancing the list of change management practices that was previously extracted from the literature review. On a wider scale, quantitative data was collected and analysed through a questionnaire survey that indicated the importance of the change management processes from the perspectives of contractors in Kuwait.

CMMs generally and wrongfully assume an equal contribution of each process towards the improvement of a specific capability within an organisation. As a solution, the principal component analysis (PCA) technique was used to cluster the change management processes within each change management stage and then an expert panel with experience in the Kuwaiti construction industry was requested to indicate the relative importance of each these processes. Based on the comparative significance of the processes and through using the Analytic Hierarchy Process (AHP), weights were assigned. Assigning weights to the processes of a capability maturity model represents one of the innovative elements that reflect the true nature and contribution of each process to reaching the goal

The initial version of the Change Management Capability Maturity Model (CMCMM) was then created. The quality and trustworthiness of CMCMM was then tested through applying it to real world scenarios and observing the performance, validity and value added by the model. The model application and verification started with an expert review followed by conducting three case studies for contracting companies located in Kuwait. The feedback from the experts review and case studies contributed to refining the CMCMM components and the utilised evaluation process. Figure 1-1 outlines the research flow and the output at different research phases where the output of each phase is used as an input to the next phase in order to eventually reach the research objectives.

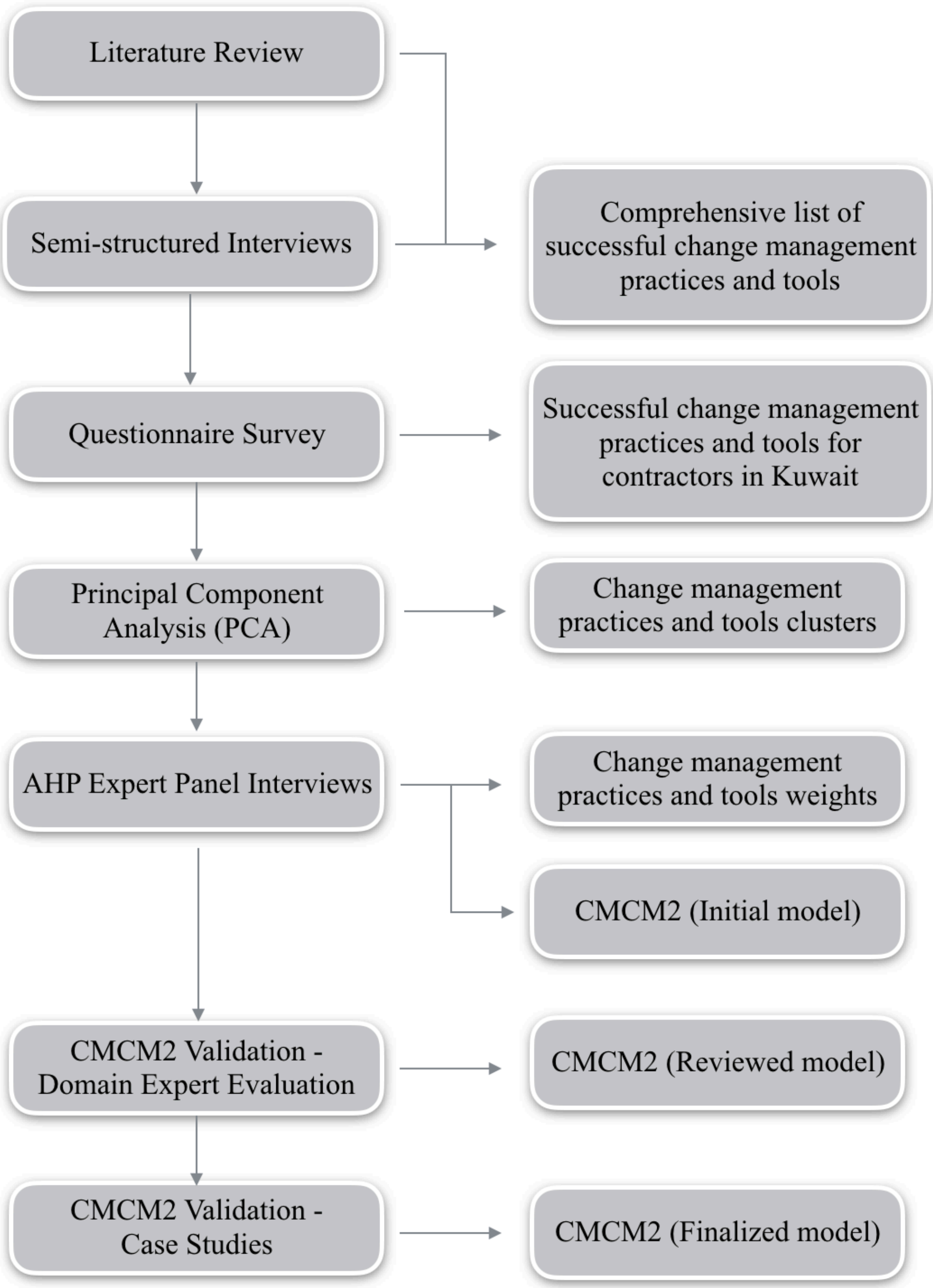

Figure 1-1 The research process flow

1.4 THESIS OUTLINE

This thesis consists of nine chapters which can be briefly described as follows:

- Chapter 1 provides an outline for the entire research, including the background and justification for research, the research aim and objectives, brief overview of the research methodology.
- Chapter 2 deeply investigated project change as found in the literature within the context of the construction industry. This exploration included the project change dimensions including change time, need, effect, process and environment. This chapter also discussed the numerous change causes in a project and its classification. Chapter 2 also considered the change effects on the project including detrimental, beneficial and neutral changes that arises in the project. Finally, this chapter focused on the frequent causes and effects of project changes in Kuwait.
- Chapter 3 rigourously reviewed the different approaches used to manage project changes as shown in the literature. A focus was given on the different practices and tools used within different change management stages including promoting a balanced change culture, identifying change, evaluating change, implementing and monitoring change and finally continuous improvement. A range of change management approaches within these stages were deeply reviewed in order to understand their strengths and weaknesses. This chapter also discussed the role of contracts in managing project changes by contractors. Chapter 3 also explored the dimensions of change management to understand the different facets of managing project change.
- Chapter 4 looked into the capability maturity models (CMMs) with a specific focus on the different improvement criteria and representation as featured in the models in the literature. This chapter started with reviewing CMMs which were developed for various domains and later on emphasis was provided to CMMs developed specifically for the change management domain in order to understand the degree of sufficiency of these models and identify the current gaps. This chapter inspired the creation of the change management capability maturity model since the improvement criteria and representation of different models were reviewed and compared.
- Chapter 5 illustrated the research methodology utilised in this research. This chapter started with reviewing the different research philosophies, approaches, methods and techniques as found in the literature to assure this research incorporates the most

suitable methodology for achieving the research aim and objectives. Different CMMs development frameworks were reviewed and the suitable framework was chosen to ensure the validity of the constructed model and it's fitness for purpose.

- Chapter 6 shows how the successful criteria of change management were verified on a wide scale through conducting preliminary semi-structured interviews followed by a quantitative questionnaire survey that was distributed to contractors in Kuwait. 52 criteria was identified and can be used to measure the fitness of the change management capability for contractors in Kuwait.
- Chapter 7 illustrated the usage of the principal component analysis (PCA) technique, Delphi technique and the Analytic Hierarchy Process (AHP) process to assign weights for the concluded 52 change management criteria. This chapter also features the creation of the initial version of the Change Management Capability Maturity Model (CMCMM). The created CMCMM model included 52 specific practices that are grouped under twelve specific goals. The model also employs the SCAMPI appraisal phases for evaluating the capability of the contractor to manage change.
- Chapter 8 shows how the quality and trustworthiness of the model was tested through applying it to real world scenarios and observing the performance and validity of the model. The model application and verification started with experts review followed by conducting case studies. These evaluation stages contributed to increasing the model's clarity, validity and user friendliness based on the constructive feedback and the actual application of the model in three different contracting companies in Kuwait.
- Chapter 9 summarises the entire research and presents how the research results achieved the aim and objectives of this study. The study's contribution to the body of knowledge and the practical implications were highlighted in the final chapter. The limitations of this study was also mentioned with highlighting the recommendations suggested for future studies as well.

CHAPTER 2 - CONSTRUCTION PROJECT CHANGE

2.1 INTRODUCTION

Project changes are represented by deviations from the original contract (Molly, 2007; CII, 1991) and are often viewed as an inevitability in any construction project (Sunday, 2010). Changes can influence the project scope, schedule and cost (Wu *et al.*, 2005; Arain & Pheng, 2005). Changes occur due to numerous triggers in the construction project thus can be grouped according to different categorisation types. This chapter will discuss change types and dimensions, change causes, change effects and finally review the frequently occurring project changes encountered by contractors in Kuwait.

2.2 PROJECT CHANGE TYPES AND DIMENSIONS

Change is any event that would cause the alteration of the project scope, duration or cost. This definition is also endorsed by Arain & Pheng (2005) through describing project change as a deviation from the previously agreed upon project scope and schedule. Egan *et al.* (2012) adds that project change is the event where the executed work is different from the work outlined in the contract and could occur in any construction project regardless of the project's type or magnitude. Other literature sources would refer to project change as project variation and defines it as the actual condition which deviates from the anticipated condition contained within the agreed upon baseline plan (PMI, 2003). Therefore, throughout this dissertation change and variation will be considered two terms that can be used interchangeably and would carry the same definition.

Change cannot be defined in an isolated manner and should be understood as a multidimensional concept (Johnson and Scholes, 1997). Erdogan *et al.* (2005) pointed out that project change could be observed through three dimensions namely; type of impact, need for change and initiation nature/responsiveness of change. The type of impact included both the beneficial and detrimental effects while the need for change dimension shows that change is either required or elective and finally the initiation nature/ responsiveness of change shows either reactive or proactive nature of changes. Similarly, Wang *et al.* (2012) conducted a thorough literature review to examine peer-reviewed articles and was successful in further detailing the change to five dimensions which includes; time, need, effect, process and environment. The purpose of the study conducted by Wang *et al.* (2012) was to provide the construction practitioners with a tool to analyse the different attributes of change as a basis for planning and evaluation purposes.

Additionally, when looking into other change classifications, the majority of literature falls in the classification of change internal and external change causes (Aven, 2014; Kerzner, 2013) or beneficial and detrimental changes (Ndihokubwayo & Haupt, 2008).

Clearly, Wang *et al.* (2012) provides the most comprehensive list of change dimensions which cover the dimensions raised by the other studies as well. For instance, the type of impact, need for change and initiation nature/responsiveness of change shown by Erdogan *et al.* (2005), are identical to the effect, need and time dimensions shown by Wang *et al.* (2012). In the same way, the dimensions shown by Aven (2014), Ndihokubwayo & Haupt (2008) and Kerzner (2013) are also covered in the study presented by Wang *et al.* (2012).

Next, the project change dimensions shall be discussed to gain a deeper understanding of the project change and its different attributes.

2.2.1 Time dimension

The time dimension of change was highly considered in the literature. Different studies considered different aspects of the time dimension when it comes to project change. Senaratne & Sexton (2011) and Kajewski *et al.* (2001) considered that a change is either anticipated or emergent based on whether the change has been previously planned for or was instantaneous in the project. Change could also be proactive, reactive or crisis based on the urgency of implementing the change (Price & Chahal, 2006; Erdogan *et al.*, 2005; Society for Human Resource, 2005; Wiele *et al.*, 2001; Burnes, 1996).

Emergent changes (otherwise known as reactive changes) are unpredictable thus are dealt with as a response to an encountered event in the project. This type of change is not originally intended to be integrated in the project (Sun *et al.*, 2006). Anticipated changes (otherwise known as proactive changes) could be properly planned and are discovered and dealt with prior to it occurring in the project (Sun *et al.*, 2006). Crisis change is considered to be urgent and vital due to various pushing factors that could be external to the project (Wang *et al.*, 2012).

Pre-fixity and post-fixity were also used to understand the time dimension of project change (Senaratne & Sexton, 2011) where pre-fixity represents changes that are anticipated before the construction phase while post fixity changes emerge in the construction phase. Many studies focused on the inception of change in different stages of project lifecycle (Senaratne & Sexton, 2011). Changes can occur in the design stage or construction stage of the project (Lazarus & Clifton, 2001). Changes occurring in the design phase of the project tends to be less damaging than the ones occurring in the latter stages (Cameron *et al.*, 2004). The main reason is that alterations in the design stage does not necessitate changes to the contractual requirements. Changes during developing the project design prior to having it fixed would be less disruptive to the progress of the project (Sun *et al.*, 2006). Changes in the design phase is easier to manage as these changes won't necessitate any rework or demolition of constructed project components (Arain & Pheng, 2006) and would add more value to the project (Zaneldin, 2000; Bearup, 1995). It is therefore crucial to properly invest time and funds in the design stage to limit changes in the consequent construction stage (Ndihokubwayo, 2008). Nevertheless, it is recommended to limit major changes in the design stage (Motawa, 2004) to avoid significant increases in the project cost (Clough & Sears, 1994) and poor performance (Oladapo, 2007).

On the other hand, changes can have a huge influence on the project when occurring in the project construction stage. Project changes have a limited effect when occurring in the early stages of the project (Ehrlenspiel *et al.*, 2007) while having a higher impact on the project progress when occurring in the later stages (Cameron *et al.*, 2004). Changes during construction would have a larger influence on the project since they often entail a cascade of unplanned changes that could negatively impact the progress of a project (Eckert *et al.* 2004). This effect is limited in the other earlier phases of the project since higher flexibility to changes is available at that time. Sweis *et al.* (2008) pointed out that the mean cost of change orders in the construction phase of the project is 5–10% of the total project value after conducting interviews with experts in the Jordanian construction industry. Bad weather was one of the most severe causes of cost escalations within the construction stage of the project (Kailua *et al.*, 2009; Kaming *et al.*, 1997). Other factors triggered change during project construction such as contractor payment delays, poor contractor management, predicaments in securing the material on site, material price increase and lack of adequate technical performance (Frimpong *et al.*, 2003).

2.2.2 Need dimension

This dimension is concerned with the extent of obligation to implement a change in the project. Ibbs *et al.* (2001) considered changes to be either elective or required. Egan (2007) also specified that changes are either discretionary or non-discretionary based on the necessity of its adaptation in the project. These two classifications are similar and preview that change could be perceived as either necessary or optional for the project.

Elective/discretionary change can be implemented to improve the overall project performance or specific area or domain. Required/non-discretionary change on the other hand is absolutely necessary for the project to be compliant with the requirement and specifications. In a nutshell, elective changes are not necessary to meet the project objectives while the required changes are compulsory for the project completion (CII, 1994). The cost to benefit ratio should be properly assessed for the elective changes prior to being implemented in the project (Ibbs *et al.*, 2001).

2.2.3 Effect dimension

Project change could be perceived as an event that provides either an opportunity or a threat (Wang *et al.* 2012; Raftery & Loosemore, 2006). The influence of a change on the project is not necessarily a negative one. Project changes are either detrimental, beneficial or neutral as (Wang *et al.* 2012; Gerardi, 2011). Detrimental changes negatively impacts the project parameters including cost, time and quality and deprives project value and producing new risks while beneficial changes would have a positive impact on the project by reducing cost, improving quality and decreasing project time (CII, 1994). Neutral changes takes the middle ground and does not influence the cost, time or quality in any noticeable manner.

2.2.4 Process dimension

Changes could occur in two distinct levels, either project or organisational levels (Erdogan *et al.*, 2005). Organisational changes are any amendments to organisational processes, organisational functions, coordination and control arrangements, changes in value, beliefs and human behaviour in terms of relationships to social rules and practices and changes in power distribution and the way organisational issues are influenced (Cao et al, 2000). The process dimension also focuses on improvement of the change implementation process (Burnes, 1992) and producing a more suitable process to manage project change (Pritchett & Pound, 1995). Regardless of the viewing this dimension from the project or the organisation level, the process dimension would view the changes in different groups including incremental, transformational and punctuated (Wang *et al.*, 2012). Burke (2008) states that incremental changes are highly frequent amongst the organisational change, tend to be low risk and quick to adapt with relatively instantaneous outcomes in the organisation. Incremental changes are usually relevant to the continuous improvement initiatives in the organisation (Hodges & Gill, 2014; Hayes, 2007). Transformational changes targets the turbulent nature of the current times and redirects the objectives, vision and identity of the organisation (Hodges & Gill, 2014). Transformational changes are also referred to as radical or quantum by other researchers (Cao *et al.*, 2000; Cummings & Worley, 1997). Finally, the punctuated changes balances between the responsiveness of incremental changes and the strategic outcomes of the transformational changes through the utilisation of what is known as transformational episodes (Hodges & Gill; 2014) which would enable the development of practices, procedures and structure in the organisation (Brown & Eisenhardt, 1997).

2.2.5 Environment dimension

The environment dimensions considers the source of change (change trigger) to look at change as either internal or external to the project (Love *et al.*, 2002). An internal change originates inside the project while an external change affects the project from the outside.

Chang *et al.* (2011) further elaborated on this dimension through sourcing project change to either the client, contractor, consultant or externally originating from unexpected factors. This classification allocates the responsible which stakeholder is responsible for causing the project change (Egan *et al.*, 2012). The environmental dimension are broadly used in managing potential project risks in a proactive manner (Sun *et al.*, 2009). This perspective could include increasing awareness of the project stakeholders of potential change triggers or the proper allocation of risk prior to the contract signing thus allowing the most suitable party to take responsibility for these changes as they arise (Sutrisna & Potts, 2002). Alnuaimi *et al.* (2010) also emphasised the significance of the environmental dimension through studying the influence of project changes on each stakeholder and concluded that contractors often take advantage of variations in the project to increase their profitability margin.

Observing the different yet associated dimensions for each project change could be the first step to improving how change is managed in the project (Wang *et al.*, 2012). Understanding these dimensions is synonymous to understanding the project change itself. The next step is to focus on how changes occur and what triggers are associated these changes.

2.3 PROJECT CHANGE CAUSES

Projects change causes are events that directly or indirectly trigger change in projects (Sun *et al.*, 2009). The literature reveals that changes are caused due to a range of factors. In order to review these changes, there is a necessity for focusing on the categorisation of change causes in order to facilitate a systematic and meaningful review of the current literature. Several studies focused on categorising change causes within the project. These categorisations will allow the deeper exploration of the studies concerned with change causes in the existing literature.

The level of categorising depth of the change causes varies from one study to the other. Some change causes categories would group change causes at higher level (internal and external) while other studies would be more specific and group these causes at a lower level (contractor related, client related, …etc.). These different categorisations are illustrated in Appendix A to show how they correlate together.

Next, an extensive review of literature was done to identify the different causes of project change and create a comprehensive list of change causes as shown in Appendix B. This approach was similarly conducted by Sun *et al.* (2009) in comprehensively specifying the causes of change which includes three levels of categorisation starting with a high level grouping followed by a lower level grouping and ending with the change cause itself. The discovered change causes were added to the suitable category to prevent any duplication in the list of change causes. Where the change cause is not categorised in the study that was found in the literature, the researcher took the liberty of adding it to the suitable change cause category. 208 change causes were identified from the literature review where 189 were considered as internal causes while 19 external causes. The following section will show the identified change causes in the literature.

2.3.1 Internal change causes

Internal change triggers are caused by factors originating from the project or the organisation (Erdogan *et al.*, 2005). Internal changes can be related to pre-requisite works, clients, contractors, detailed design, consultants, materials, tools/equipment, labour, donors, job site conditions, management/supervision/information flow and transportation. When reviewing these change causes, it can be noticed that a clear overlap exists between these categories. For instance, the lack of coordination could be categorised under several categories at the same time. Therefore, it is important to focus on the context of the change cause within the specified category (i.e., when lack of communication is mentioned under the contractor related change causes, it implies that a change was caused due to the lack of the contractor's communication with other stakeholders).

Change related to pre-requisite or works connectivity are caused by the association between different tasks in a project. Changes can be triggered by delays in acquiring work permit, non-completion of previous connected work, lack of quality in previous work and incompetent inspections of previous work (Wambeke *et al.*, 2011).

Client related change causes include the introduction of new requirements (addition & omission of project scope), lack of adequate speed in decision making, unrealistic contract duration imposed by the client, financial issues faced by the client, adjusting the required project specification, incomplete and/or incorrect information by client, schedule changes by client, replacement of materials or procedures by client, inflexible client, site accessibility delay by client, delays in approving and revising of design documents by client, delays in approving shop drawings by client, delays in approving materials by client, lack of communication by client, conflicts between the joint ownership in the project, unavailability of incentives for contractor, influence of other units associated to the client, land allocation problems and finally inadequate experience of client's staff.

Change causes related to the contractor included inadequate planning and scheduling, inadequate site supervision, inadequate site management, inadequate experience level, delays in the subcontractor's work, incompetent labour, financing difficulties by contractor, poor communication by contractor, poor coordination by the contractor, lack of site and local constraints awareness, incompetence of the contractor's construction manager, inadequate management abilities, improper control over site resource allocation, improper management structure of contracting organisation, conflicts in sub-contractors' schedules, construction errors by contractors, conflicts between contractor and client or consultant, unavailability of necessary information for the contractor, improper construction methods, frequent change of sub-contractors, delay in site mobilisation, contractor abuses the variation clause in the contract, lack of equipment, increased profitability required by the contractor, design and technological complexity required from contractor and the contractor's stubborn nature.

The consultant related changes are caused by lack of consultant experience and familiarity with the regulations and construction permits, inadequate design by consultant, conflicts between contract documents, lack of coordination by consultant, lack of knowledge of available materials and equipment, lack of experience by the consultant's supervisors, inadequate supervision by consultant, improper scope of work, technology change utilisation, value engineering, design complexity, inadequate working drawing details, inadequate shop drawing details, stubborn nature of consultant, ambiguous design details, design discrepancies, design is not compliant with government regulations, design is not compliant with owner's requirement and change in specifications by consultant.

Changes can also be sourced to management/supervision/information flow related triggers including poor leadership by management, inadequate skills by management, inadequacy and unpredictability of decision making, goals and values alterations, technical system alterations, organisational structure alterations, management philosophy alterations, psychological system alterations managerial system alterations, organisational culture alterations, system of internal power and control alterations, providing information about the design or drawing is slow, lack of supervisor guidance and instructions, lack of field manager or foreman skills and/or knowledge, lack of coordination between different trades, unrealistic commitments due to tight work schedule, lack of foreman availability, scope of work alteration, lack of communication skills by foreman, lack of communication between client/engineer and project manager and lack of communication between project manager and foreman.

The design related change causes include errors and conflicts in design documents, inconsistency between drawings and site conditions, delay in design information, unclear and inadequate design, inadequate experience of the design team, design complexity, slow-paced design approval process, errors in quantity estimations, omissions in quantity estimations, incorrect specification, misunderstanding of owner's requirements by design engineer, inadequate engineering software usage, lack of coordination by designer, designer overwhelmed with excessive work load, low design constructibility, strict specification requirements, inadequate design process quality control, work sequence or method is not well planned and repeatability of design is inadequate.

Change causes can be related to material such as delay in material delivery, shortage of construction materials in market, noncompliance with material requirements, material need to be in the right place when needed, changes in material types and specifications during construction, damage of sorted material while they are needed urgently, delay in manufacturing special building materials, late procurement of materials, delay in selecting the finishing materials due to availability of many types in market and finally securing the consumables required for the project.

Tools and equipment can cause changes due to equipment shortage, equipment breakdown, equipment-operator's inadequate skill, low productivity and efficiency of equipment, lack of advanced technology, personnel lift (unavailable, no operator, not the priority, maintenance), power tools (inadequate training, used by someone else, misplaced, maintenance), crane or forklift (unavailable, no operator, not the priority, maintenance), hand tools (used by someone else, misplaced, maintenance), other heavy equipment (e.g., backhoe, loader, dump truck) not available, personal protective equipment (PPE) (not enough, used by someone else, misplaced, unserviceable) and improper selection of equipment.

Labour related issues can also cause changes for reasons such as labour shortage, unqualified workforce, low productivity level of labour, socialising with fellow workers, constant absence, people arriving late and/or leaving early because of illness, injury, family or personal reason, low morale and/or lack of motivation, getting moved to another job/task before the one you were working on was completed, inefficiencies associated with personnel turnover (i.e., new employees), language barrier among workers and/or worker-supervisor, nationality of labour and personal conflicts among labour.

Work/job site problems can cause project change as a result of site congestion, difficult access to the work area, site layout (excessive distance between material storage and required location of work), differing site conditions and safety measurements requirements.

Enshassi *et al.* (2010) focused on issues related to donors and emphasised the significance of these issues on creating project changes in Gaza Strip. These issues include the lack of financial capability of donor, budget constraint, time constraint, interference of donor in project requirements.

2.3.2 External change causes

External factors also caused change such as unforeseen site conditions, change of decision-making authority, unpredictable weather conditions, legislative or policy changes, political pressure, natural disaster, expected geological conditions, local residents, other organisations influence, effects of subsurface conditions, delay in obtaining permits from municipality, unavailability of utilities in site (water, electricity, telephone, … etc.), effect of social and cultural factors, traffic control and restriction at job site, accident during construction, safety considerations, changes in government regulations and laws and economical conditions.

2.3.3 Ranking of project change causes and effects in the worldwide industries

The previous sections previewed the internal and external change causes presented in the literature. The next stop is to review the studies that ranked the causes of change in the construction industry in order to understand the frequent and significant causes project changes as perceived by industry practitioners. It is important to fully understand the frequency and significance of change causes and effects as presented in the literature before focusing on the topic of managing change. Gaining perspective on the frequency and significance of different project changes would eventually contribute to creating a practical solution which posses a high fitness for purpose. Additionally and to gain proper insight into the matter, this section features studies focusing causes of project change in different parts of the world.

Sambasivan & Soon (2007) ranked the change causes in the Malaysian construction industry. The researchers ranked the causes of change starting with contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labour supply, equipment availability and failure, lack of communication between parties and mistakes during the construction stage in subsequent order. Another study by Rosenfeld (2014) focused on representing the worldwide construction industry where the concluded root triggers of project change were premature tender documents, insufficient information about ground conditions, too small a design budget, Force majeure, changes in owner's requirements, late start of the planning process, low a budget, insufficient owner's brief, lack of adequate personnel, cultural conflicts and lack of trust, low constructibility of design, low tender prices, in adequacy of designers' standard requirements professional liability, premature tender documents, risk distribution between the client and contract is unbalanced and unclear division of responsibilities and lack of professional management necessity. Additionally, Rosenfeld (2014) particularly underlined that premature tender documents, changes in owner requirements and awarding tenders based on the lowest price are specifically the highest ranking roots of change in construction projects.

Enshassi *et al.* (2010) also ranked the causes of change in construction projects located in Gaza Strip and realised that the leading cause is the lack of construction materials and equipment spare parts followed directly by the consultant's constant change of design and lack of knowledge about the available materials and equipment. The following causes were errors and omissions in design, contradicting contract documents, financial issues and lack of coordination in addition to change in specification by owner. Arain & Pheng (2005) focused on the change causes of institutional buildings projects located in Singapore. The ranked causes started with change of plans or scope by the project owner, unpredictable issues, defective work, change in specifications by owner and safety consideration.

When looking into these studies, the used research methodology is comparatively similar. The first factor is majorly using the questionnaire survey to collect the data regarding the ranking of change causes in the project (Amoatey *et al.*, 2015; Rosenfield, 2014; Enshassi *et al.*, 2010; Sambasivan & Soon, 2007; Arain & Pheng, 2005; Al-Tabtabai, 2002). The majority of the reviewed studies considered used a five-point Likert scale to rate the change causes in the questionnaire survey (Enshassi *et al.*, 2010; Sambasivan & Soon, 2007; Arain & Pheng, 2005; Al-Tabtabai, 2002). The studies observing the change causes in the Kuwaiti construction industry either used a questionnaire survey (Jarkas and Bitar, 2012; Al-Tabtabai, 2002) or interviews (Koushki and Kartam, 2004). Sambasivan & Soon (2007) used the questionnaire surveys to rank the factors causing change in the Malaysian construction industry. The questionnaire survey had a total of 150 respondents including clients, consultants and contractors. The questionnaire was set to determine the respondent's background, ranking causes and effects of change by using a five-point Likert scale. Rosenfeld (2014) also used 200 cross-sectional surveys with 195 respondents and targeted construction managers who are mostly engineers in order to rank a list of 146 potential causes of worldwide project cost variations and used root-cause analysis to conclude that these causes can be filtered and merged into 15 universal root triggers on the basis of that project cost overrun is a universal issue thus these findings of this study is targeting worldwide construction industry. The respondents were either public clients, client representatives, contractors, designers, consultants and private owners. It is worth mentioning that the formation of the list was completed by literature surveys and expert brainstorming while the ranking of these causes was done by utilising the formerly mentioned surveys. The next factor of comparison is the current positions of the questionnaire respondents who are providing the ranking in the construction industry.

Some studies focused on extracting the opinions of the clients, consultants and contractors (Amoatey *et al.*, 2015; Rosenfeld, 2014; Enshassi *et al.*, 2010; Sambasivan & Soon, 2007) while others focused on project architects, senior architects and principal architects and directors of their organisations (Arain & Pheng, 2005) or even the governmental management and personnel, contractors and designers (Al-Tabtabai, 2002). The sample size varied widely between these studies to include 195 respondents (Rosenfeld, 2014), 150 respondents (Sambasivan & Soon, 2007), 76 (Enshassi *et al.*, 2010), 48 respondents (Al-Tabtabai, 2002), 47 respondents (Yang & Chen, 2015), 31 respondents (Amoatey *et al.*, 2015) and 28 respondents (Manzoor Arain & Sui Pheng, 2005). Next, the response rate of the questionnaire surveys used in these studies was reviewed. Some researches consider response rate between 20% - 30% percent as satisfactory for research concerned with the construction industry (Dulami *et al.*, 2003; Akintoye, 2000) while other studies expect a minimum response rate of 23% (Arain & Pheng, 2005).

After reviewing the different studies that used the questionnaire survey in collecting data to rank change causes, it was acknowledged that response rates included 97.5% (Rosenfeld, 2014), 76% (Enshassi *et al.*, 2010), 78.3% (Yang & Chen, 2015), 75% (Sambasivan & Soon, 2007), 51.7% (Amoatey *et al.*, 2015), 40.24% (Arain and Pheng, 2005), 32% (Al-Tabtabai, 2002). In other word, these response rates satisfy the minimum requirements and should provide a valid input for change cause ranking.

Ranking the change causes was done by considering different criteria in these studies. The ranking of the change causes was either based on overall significance (Enshassi *et al.*, 2010; Sambasivan & Soon, 2007; Al-Tabtabai, 2002), impact on cost (Rosenfeld, 2014), frequency of occurrence (Arain & Pheng, 2005) or both criterions by requesting two ratings within the same survey (Amoatey *et al.*, 2015).

Some rankings took into consideration the project type and ranked the change causes accordingly. Al-Tabtabai (2002) specified that the ranking of the change causes were specifically for governmental building and housing projects in the Kuwaiti construction industry. Rosenfeld (2014) targeted the ranking of change causes based on the respondents' involvement in either building or infrastructure projects. To the contrary, Sambasivan & Soon (2007) did not define the specifically targeted type of projects considered in the research in contrast to the approach adopted by Al-Tabtabai (2002) and Rosenfield (2014).

The use of the Relative Importance Index (RII) developed by Kometa *et al.* (1994) is clearly widespread in the literature that aims to contrast the perspective of different stakeholders' opinions when it comes to causes and effects of change. The respondent would choose between 1 to 5 to indicate the importance of a specific factor with 1 being "not significant" and 5 being "extremely significant". The Relative Importance Indices (RII) was utilised by a wide range of researchers (Enshassi *et al.*, 2010; Sambasivan & Soon, 2007; Al-Tabtabai, 2002) to combine the perspective of different professional groups and specify the ranking of change triggers based on a combined opinion. This approach is very beneficial in understanding the opinions of diverse project participants and contrasting the results as shown (Tabtabai, 2002).

Clearly, most of the studies ranked change causes on the basis of the respondents' subjective opinions. To the contrary, Taylor *et al.* (2012) focused on ranking the change causes on a more robust and objective basis which is resembled by the change orders documented for the Kentucky highway projects . The ranking was set based on both frequency and cost of change orders recorded by the Kentucky Transportation Cabinet.

2.4 PROJECT CHANGE EFFECTS

The changes effect on the project is a main point of concern and is considered one of the dimensions that define the project variations (Wang *et al.* 2012). To facilitate the comprehensive review of change effects, a systematic approach to the literature should be followed. Wang *et al.* (2012) mentioned that the influence dimension includes detrimental, beneficial and neutral changes. Building on that, the next part will look into the range of project changes effects based on the change's influence dimension mentioned by Wang *et al.* (2012) to facilitate a comprehensive review of the change effects pointed out in the literature.

2.4.1 Detrimental change effects

Change can have a negative effect on various elements in the project. The project changes effect on the project costs was emphasised as one of the most critical effects in the literature. The United States construction industry suffers from spending USD 13–26 billion per year due to construction change orders (Hanna and Gunduz, 2004). Project change was the reason for increasing the project cost by 1% to 115% in the Kuwaiti construction industry (Al Duaij *et al.*, 2007). Cost overruns were widely encountered in the construction projects of Zambia due to the Hugh frequency of project changes (Kaliba *et al.*, 2009). Project changes can have a direct or indirect impact on cost (Sun *et al.*, 2009; Ndihokubwayo & Haupt, 2008; Ibbs *et al.*, 1998).

Direct costs of change orders can include the escalation of total project cost, additional payment to the contractor and increase in overhead expenses (Arain & Pheng, 2005). Direct costs also includes payment for additional labour, material, plants, carrying out the substituted work, demolition and resources in a study conducted in Gaza Strip (Enshassi *et al.*, 2010). The cost of the project can be influenced indirectly through the rise of claims and legal disputes (Ibbs *et al.*, 1998) or litigation costs (Ahmed *et al.*, 2002). Through conducting seven case studies for construction projects located in China, it was recognised that the indirect cost of change orders represented by redesign costs resulted in escalating the total project cost with by USD 1.1 millions to USD 40.5 millions (Chang & Choo, 2011).

Another effect of change is on the project duration and schedule (Sun *et al.*, 2009). In four case studies in Oman, project changes expanded the duration of the project ranged by 8.57% to 100% where water transmission projects faced the least delays (52 days) while the building projects was suffered with the highest time extension (365 days) the other three cases (Alnuaimi *et al.*, 2010). Koushki and Kartam (2004) focused on the changes in the project duration due to material related changes by conducting interviews with 450 project owners of small, medium, and large private residential projects located in Kuwait. The study showed that 30.4% of the projects were delayed by 1-3 months, 29% were delayed by 4-5 months, 22% were delayed by 6-8 months and 18.8% were delayed 9 months or more. Kaliba *et al.* (2009) similarly studied the schedule delays in road construction projects located in Zambia and recognised that schedule overruns were significantly encountered in these projects. Garthwaite and Eckert (2012) examined three case studies related to hospital refurbishment projects with the client being the UK National Health Service (NHS). The negative impact of the project changes on the schedule and activity float time was clear in these case studies (Garthwaite and Eckert, 2012).

Project changes also had other detrimental effects on the project such as the degradation of quality (Assaf *et al.*, 1995), out-of-sequence work (Koskela, 2000), trade stacking (Riley *et al.*, 2005), overmanning and site congestion (Jarkas & Bitar, 2012), staff morale and labour productivity (Moselhi *et al.*, 2005; Barrie & Paulson, 1996).

2.4.2 Beneficial change effects

Changes could also have a rather positive effect on the project. Ndihokubwayo & Haupt (2008) highlights that variations could be beneficial when it comes to increasing project functionality, durability, eliminating unnecessary cost and maximising client satisfaction. Beneficial project changes could also include quality improvements, cost reductions, project duration reduction in addition to optimising the feasibility of the project (Arain & Pheng, 2005). Beneficial design changes could add value to the client business and support the clients strategy (Lee & Pena-Mora, 2007). Beneficial changes should be perceived as positive on the long-term rather than on the short-term (CII, 1994). In other words, changes that may influence the project negatively later on yet is perceived positive at the moment should not be supported in the project. It is also worth noting that it is critical to recognise potential positive changes in the early stages of the project to gain the benefits of these changes (Ibbs, 1998; CII, 1994).

2.4.3 Neutral change effects

Changes that occur without any effects the project parameters. In other words, these changes do not cause schedule delays or cost escalations of the project (CII, 1994) for reasons such as the availability of time floats in the project schedule and contingency funds. With proper management, neutral changes can be shifted to being beneficial for the project (Wang *et al.*, 2012).

2.4.4 Ranking of project change effects

This section shows the ranking of change effects on the project aspects as featured in the literature. Alnuaimi *et al.* (2010) used a questionnaire survey in determining the effects of the project changes in four public projects in Oman. The survey targeted clients, consultants and contractors by asking them to rank overall change influence in the project using a Likert scale. They then ranked all effects using the Relative Importance Indices (RII) approach based on 33 valid responses to combine the opinions provided by different professional groups. The utilisation of RII also supports the comparison between different professional groups' opinions (Alnuaimi *et al.*, 2010) and understand which group of professionals provided the closest opinions to the overall ranking (Rosenfeld, 2014).

The effects of change ranking first features delay completion date of projects followed by claims and disputes, cost overruns, low performance, lack of moral and finally degrading project quality. Alnuaimi *et al.* (2010) took one step further by identifying the benefiting stakeholders from these changes and concluded that the most benefiting party of these project changes was the contractor followed by the consultant and finally the client. Arain & Pheng (2005) used a questionnaire survey for ranking the potential effects of variation orders on institutional building projects located in Singapore. The survey was sent to working governmental agency and experienced professionals in institutional projects.

The survey structure included two sections where the first section was concerned with the general characteristics of the respondents while the second section required the respondent to use a five-point Likert scale in order to rate the effect of 16 variation factors based on the frequency of occurrence. After collecting the data, the effects of change were ranked showing that the increase in project cost is the most frequent change effect followed by additional payment for contractor, less progress without delays, schedule delay, increase in overhead expenses, rework and demolition. Nonetheless, this paper has various shortcomings when appraised against other similar studies.

Some studies focused on the ranking of change effects originating from a particular trigger on the project. Sambasivan & Soon (2007) also used a questionnaire survey to establish ranking of the impact of project changes in the Malaysian construction industry. The questionnaire survey received a total of 150 responses from clients, consultants and contractors and explored the effects of changes in time on the project aspects using five-point Likert scale. The perspectives of the different stakeholders were analysed in the ranking preparation process. The respondents ranked the effects of change from the highest to the lowest significance starting with time overrun, cost overrun, disputes, arbitration, litigation and finally total abandonment respectively. Amoatey *et al.* (2015) also studied the change effects in state housing construction projects located in Ghana. The researchers conducted a questionnaire survey which received 31 responses. The respondents also ranked the effects of time related changes from the highest to the lowest starting with cost overrun, time overrun, litigation, lack of continuity by client and arbitration respectively.

The studies show that the ranking of change effects varies between the Omani, Malaysian and Ghanian construction industries. The reason can be due to different conditions and experiences would lead to different rankings of change effects in each industry (Alnuaimi *et al.*, 2010). It can be realised that these studies were solely based on the opinions of the participants rather than objective evidence. Increased objectivity in the data collection process would potentially aid the more reliable conclusions and correlating patterns of project change effects. Objectivity could potentially be enhanced by reviewing project documentation that reflects the true effects of changes on the project parameters.

2.5 PROJECT CHANGES CAUSES AND EFFECTS IN KUWAIT

Project change is a major point of concern in worldwide construction industries as it is previously shown. Similarly, the Kuwaiti construction industry suffers from unsatisfactory project outcomes due to changes in the public and private projects (Al Duaij *et al.*, 2007). Change orders are viewed as a significant factor that negatively influences the project's cost and time restrictions (Koushki *et al.*, 2005) in addition to having an adverse influence on the relationship and interconnection between the owners, engineer, contractors, subcontractors and other involved stakeholders (Alaryan *et al.*, 2014). This section then will specifically fixate on the researches studying the change causes and effects in the local construction industry of Kuwait.

Alaryan *et al.* (2014) studied the change orders with specific focus on construction projects which were located in Kuwait and utilised a questionnaire survey to receive the input of 385 owners, contractors and consultants that were involved in such projects. The main focus of this research was to exploit the causes and effects of change orders and their effects on public and private construction projects in Kuwait.

The hypothesis testing was used to ensure a suitable level of agreement was reached among the feedback of owners, consultants and contractors. Alaryan *et al.* (2014) used the One-Way ANOVA test on the mean values of the change orders causes and effects to compare the results between the three data groups which collected from the owners, contractors and consultants. The results show that the change of plans by the owner is the most common source of changes followed by scope enhancement by the owner, site issues, eliminations in the design and finally improper detailing of working drawings (Alaryan *et al.*, 2014). On the other hand, increased cost of the project is the most widespread effect followed by increased duration in project activities, completion delays, additional payment for the contractor and finally delayed payment (Alaryan *et al.*, 2014).

Almutairi (2016) thoroughly studied the causes of schedule changes and completion time delays in the construction projects which were located in Kuwait. The study was built on the feedback of 22 respondents who were practicing engineers in Kuwait at that point of time. Almutairi (2016) used the Relative Important Index (RII) in order to establish a ranking for the causes of schedule and completion time changes in addition to using the Rank Agreement Factor (RAF) to measure the degree of agreement between the questionnaire respondents regarding the ranking. As a result, Almutairi (2016) concluded that the most pressing matters which would cause time overruns is the utilisation of the lowest price bidding and tendering system in addition to the weak performances by the main contractor and subcontractor followed by improper experience or qualifications of the main contractor's staff. The successive cause was connected to the client where delays in payment was perceived as a serious issue that triggers delays in the project completion date. Another issue caused by the client was the delay in the decision making process. Other problems including general labour shortage, recurring substitution of subcontractors in the project, inadequate handling of subcontractors and conflict between project stakeholders were also highlighted by the respondents as a main trigger for the issue of duration changes.

Koushki *et al.* (2005) investigated the degree of time delays and cost overruns through using a face to face questionnaire survey which collected data regarding 450 private housing projects located in 27 different districts in Kuwait. This huge effort required the formation of a research team including one graduate and two senior civil engineering students for efficiency in the data collection process. The respondents (owners) provided data about changes in design duration, design cost, construction duration, construction cost, material cost, overall project time increase and finally overall project cost increase. Based on the responses, 47% of the respondents confirmed that their projects encountered one or more variation orders in the design phase. Design related changes also occurred during the construction phase in 49% of the projects as a step to correct design errors and unclear design detailing. The change orders affected both the overall cost and time of the project as indicated by the respondents. The selected projects illustrated a mean increase of 7.8% in the total cost and 29.1% time increase due to variation orders the residential projects (Koushki *et al.*, 2005). Koushki *et al.* (2005) also claimed that 71% of the projects that did not encounter variation orders on schedule were completed on time while only 45% of the projects encountering variation orders were completed on time.

Koushki *et al.* (2005) confirmed that properly conducting pre-planning and design activities reduce undesirable project variations in the implementation phase of the project thus concluding that owners willing to invest more time and funds in the pre-planning phase would be less prone additional project time and costs.

Koushki & Kartam (2004) studied the effects of material related changes in residential building projects in Kuwait as a part of research project that conducted a survey for the same 450 owners of the residential projects in Kuwait. The study positively contributes to comprehensively examines the influence of a specific change causes (material related) on the project progress. Koushki & Kartam (2004) confirmed through analysing the results of the surveys that material delivery determined by material type and availability in the local market would highly impact the final project cost and time and that project delays were sourced to variations in material selection time, type, availability in the local market and the lack of site work as shown by the authors.

Both studies were limited by not specifying the responses' accuracy and if these responses were based on documented evidences such as the change orders documents or records. Nonetheless, it is worth noting that collecting objective evidence for research purposes is a daunting process for two reasons. The first reason being the reliability of the documents (Taylor *et al.*, 2012) and the second being the availability and accessibility of the project related documents (Koushki *et al.*, 2005). Al Duaij *et al.* (2007) also analysed project variation orders in 15 construction projects located in Kuwait and realised that variation orders are majorly originating from new client requirements, contractor claims, change of construction methods and sequence, discrepancies between plans and specifications in addition to differing site conditions.

On the other hand, Al-Tabtabai (2002) analysed and ranked the causes of project delays of governmental building and housing projects in the Kuwaiti construction industry. 150 questionnaire surveys were sent to governmental management and personnel, contractors and designers. 48 respondents participated in the questionnaire survey representing a 32% response rate. The questionnaire contained factors causing project delays which are grouped under eight categories namely; client administration and organisational, client's site supervision, contractor related, labour related, quality related, design related, project management related and contractual related. Al-Tabtabai (2002) concluded that the designers and contractors ranked client's limited authority to approve minor changes on site, approval of new construction alternatives and slow processing of the contractor's payment to be the top ranking causes of changes in project duration. The study also highlighted that poor contractor site management, lack of planning, late mobilisation and misinterpretation of drawings and specifications were ranked as the top change causes by the clients. Eventually, the respondents agree that project management related causes of delay are the top ranking roots of project duration changes while contractual related change causes were the lowest in ranking.

It is important to emphasise that this study's response rate is considered low in comparison with other similar studies gaining a response rates of 97.5% (Rosenfeld, 2014), 76% (Enshassi *et al.*, 2010), 78.3% (Yang & Chen, 2015), or 75% (Sambasivan & Soon, 2007). This low response rates is highly expected in this type of research yet it could be increased through allowing the respondents to return a soft copy or a hard copy of the completed questionnaire survey (Ruqaishi & Bashir, 2015). It is considered that a 28% response rate was adequate for this type of research as clarified by Ruqaishi & Bashir (2015) thus the 32% response rate of survey conducted by Al-Tabtabai (2002) should be considered relatively adequate. No pilot survey was used by Al-Tabtabai (2002) to determine the effectiveness and clarity of the survey instrument in collecting data and fulfilling its intended purpose. The importance of this pilot test is to evaluate the reliability of the questionnaire prior to distributing in on wider scale (Tavakol & Dennick, 2011).

2.6 SUMMARY

This chapter deeply investigated project change as found in the literature within the context of the construction industry. This exploration included the project change dimensions including change time, need, effect, process and environment. Next, this chapter discussed the numerous change causes in a project and its varying degree of classifications. This chapter also previewed the effects of project change on the project including detrimental, beneficial and neutral changes that arises in the project. Finally, the review focused on project changes in Kuwait with emphasis on the frequent causes and effects of these changes. The next step is to review the literature concerned with the management of these project changes in order to explore techniques and processes are used to optimise the influence of changes on the project progress.

CHAPTER 3 - PROJECT CHANGE MANAGEMENT

3.1 INTRODUCTION

The previous chapter explored the project change dimensions, causes and effects. Clearly, changes can be either damaging to the project progress or could represent a good opportunity to boost the value delivered to the client. Project changes are encountered universally with the construction industry of Kuwait being no exception for this influence. Therefore, managing change adequately would facilitate better outcomes in the construction project. Change management is the application of a structured practices and tools to guide the project team in achieving a required outcomes (Prosci, 2014). It is the project management discipline process that is connected to internal and external events triggering project changes (Voropajev, 1998). Change management is a vital dimension in project management (Zhao *et al.*, 2010) and forms a component of the overarching framework of securing and delivering the project objectives (CIRIA, 2001). This chapter focuses on different methods and techniques presented in the literature in order to gain a better understanding of how change is managed in construction projects.

Prosci (2016) points out that project change management comprises five dimensions which includes people, process, tools, methodologies and finally results and outcomes. The dimensions raised by Prosci (2016) are very similar to the dimensions pointed out by Paulk *et al.* (1993). The people dimension is concerned with the stakeholders performing the change management in the project and how different dedication of resources to this purpose affects the integration of change management. Moreover, the preparedness of the stakeholders managing change is considered within this dimensions. The process dimension is concerned with how the change management is conducted through the lifecycle of the project. This dimension also addresses how activities would take place to deliver a specific output of the integrated change management process. The tools dimension is concerned with the instruments, techniques and methods used to achieve the deliverables of change management in the project. The methodology dimension is concerned with the institutionalisation of change management across the projects undertaken within the organisation otherwise known as the enterprise change management (Prosci, 2016). The results and outcomes dimension on the other hand is concerned with the observation and analysis of change management outcomes and continuously improving its contribution to project success (Prosci, 2016).

3.2 CHANGE MANAGEMENT STAGES

As a part of enabling project objectives, change management is applied through different stages similar to any other project management knowledge area such as schedule management, cost management, risk management, …etc. It is clear that different studies focused on the stages of managing project change and provided a descriptive guidance for these stages and their outcomes. Table 3-1 shows the different stages of the change management according to diverse literature sources.

Table 3-1 Change management process in different literature sources

Source	Stages				
CII (1994)	Promote a balanced change culture	Recognise change	Evaluate change	Implement change	Continuously Improve from Lessons Learned	
PMI (2013)	Identify changes	Change request	Approval	Change control	Update project documents	
Lazarus & Clifton (2001)	Promote a balanced change culture	Recognise change	Evaluate change	Implement change	Continuously Improve from Lessons Learned	
Ibbs *et al.* (2001)		Recognise changes	Evaluate changes	Implement changes	Learn from previous experiences	
Motawa *et al.* (2007)	Startup	Identify and evaluate	Approval and propagation	Post change		
Molly (2007)	Evaluate the contract	Identify the change	Notify parties of change	Document the change	Prepare change request	Resolve change request
Arain &Pheng (2007)	Identify variation for promoting a balanced variation culture	Recognise variation	Diagnosis of variation	Implement variation	Implement controlling strategies	Learning from past experience
Arain (2008)	Identify variation for promoting a balanced variation culture	Recognise variation	Diagnosis of variation	Implement variation	Implement controlling strategies	Learning from past experiences
Hao *et al.* (2008)	Identify changes	Evaluate and propose changes	Approve changes	Implement changes		
Egan *et al.* (2012)	Address potential changes in the contract documents	Identify the potential change.	Create a proposed change order and document the proposed change.	Review and evaluate the proposed change order timely	Execute the change order	Document the executed change
Chen *et al.* (2015)	Identification	Confirmation	Notification	Implementation	Closure	

The literature provides several studies concerning the stages for managing project change and these stages have a great degree of similarity as shown in the table. Commonalities and differences between these stages need to be examined in order to facilitate a systematic literature review and regulate the review of literature within change management stage.

Most of the change management processes start with promoting a balanced change culture (Arain, 2008; CII, 1994). This stage focuses on the preparation of the project team and conducting proper planning processes in order to increase the change readiness in the project (CII, 1994). Regardless of the different wording, this stage is similar to the startup phase presented by other studies and requires the team to be prepared to manage change through the development of appropriate processes to promote beneficial changes and mitigate detrimental changes (Motawa *et al.*, 2007). Moreover, other studies consider the evaluation of the project contract to be the first step in the management of change. It is worth mentioning that even though not all the studies mentions this stage, they do address the same concern of spreading awareness concerning project changes and enhancing team preparation to manage such changes under other naming. For instance, Motawa *et al.* (2007), suggested that the startup phase should prepare the team for managing upcoming project changes which is identical to the promoting a balanced change culture stage.

The next stage of managing project change is recognising change (Arain, 2008; Ibbs *et al.*, 2001; CII, 1994). Other studies refer to the same stage as identifying change (Chen *et al.*, 2015; Egan at al., 2012; Has *et al.*, 2008; Motawa *et al.*, 2007; Molly, 2007; Arain & Pheng, 2006). Identifying change is related to acknowledging the project's actual progress or outcome deviations from the planned parameters or specifications. Different change dimensions are investigated and reported in this stage to assure full understanding of this change prior to taking any decisions.

Subsequently, the change evaluation stage is required in the change management process (Chen *et al.*, 2015; Egan at al., 2012; Has *et al.*, 2008; Motawa *et al.*, 2007; Molly, 2007; Arain & Pheng, 2006). This stage ensures that the impact of change is fully studied and explored on the diverse aspects of the project such as cost, time, risk, … etc. For instance and if the change was elective, this stage will be pivotal for the approval or declination of the change implementation. If the change was compulsory, then this stage will explore how this change needs to be dealt with in the project.

The project implementation and monitoring stage follows change evaluation (Chen *et al.*, 2015; Egan at al., 2012; Arain, 2008; Has *et al.*, 2008; Motawa *et al.*, 2007; Molly, 2007; Arain & Pheng, 2006; Ibbs *et al.*, 2001; CII, 1994). This process includes communication with the correct team members and securing the required authorisations to implement the project change and monitoring the outcome. That would be in addition to reflecting the changes in the project documents including cost, schedule, scope, … etc. This stage also includes the monitoring of the change implementation having a communications plan that involves the relevant stakeholders for progress reporting.

The final change management stage focuses on continuous improvement in the project through learning from previous experiences Chen *et al.*, 2015; Egan at al., 2012; Arain, 2008; Has *et al.*, 2008; Motawa *et al.*, 2007; Molly, 2007; Arain & Pheng, 2006; Ibbs *et al.*, 2001; CII, 1994). This stage requires using proper documentation throughout the project in order to transfer the acquired experience and knowledge to the project team or throughout the organisation itself. Learning from previous lessons would eventually ensure an increased team readiness and a better capability to manage change in future projects.

It is clear that the different change management process stages presented in the literature have a huge overlap in terminology and content. In order to retain consistency in this research, a unified terminology will be used. Therefore, the change management stages are named as promoting a balanced change culture, identifying change, evaluating change, implementing and monitoring change and finally continuous improvement.

3.3 CHANGE MANAGEMENT PRACTICES AND TOOLS

In this section, the change management related literature shall be explored and reviewed according to the previously highlighted change management process stages. Therefore, the change management practices and tools shall be reviewed within the promoting a balanced change culture stage, identifying change stage, evaluating change stage, implementing and monitoring change stage and finally the continuous improvement stage.

3.3.1 Promoting a balanced change culture

This change management stage is concerned with spreading awareness of the true meaning and potential influence of detrimental and beneficial project changes (CII, 1994). This stage is also focuses on limiting future changes through establishing proper initiation and planning practices and techniques (CII, 1994). The concept of differentiating between the contrasting change types should be introduced to increase the project team's change readiness (Ibbs *et al.*, 2001) and their capability to properly manage project changes and targeting resilience within the team. Project resilience is the ability to bounce back from effects of detrimental changes in the project (Harrington *et al.*, 2000).

The prevention of detrimental changes in the project is a focal point of concern in the literature. The utilisation of value engineering systems in the project may prove very beneficial in limiting the possible rise of negative changes in the project (Ibbs *et al.*, 2001; CII, 1994). The identification of areas potential changes at the early stages of the project could prove beneficial in limiting the detrimental change effect in the project (Ibbs *et al.*, 2001). Additionally, reviewing the lessons learned and documentation of previous projects would contribute to improving the early recognition of potential areas of change (Arain & Pheng, 2006). A rigourous analysis should also be used to determine the criteria for justifying the implementation of elective changes in the project and allocating the accountability for this change (CII, 1994).

It is also important to intently study the contract document to properly manage project changes later on in the project (Egan *et al.*, 2012). Having a change clause in the contract is beneficial for all parties involved in the project and specially when the contractor deserves a reimbursement due to force majeure (Egan *et al.*, 2012). Molly (2007) also confirmed the significance of properly understanding the contract document requirements in the initial stages of the project to be properly equipped to manage change appropriately. A perspective that was supported by Alaryan *et al.* (2014) by stating that proper checking and reviewing of the contract documents is the most important methods to limit changes at early stages. Additionally, nurturing beneficial project changes should also be done in this stage of change management. This could include communicating and documenting factors that have positive influence on the project progress and appreciating the efforts done concerning the initiation of positive changes in the project (CII, 1994).

Facilitating proper training for the project team in utilising the organisational change management system is essential for increased change preparedness (CII, 1994). The Prosci 2013 best practices in change management benchmarking study identified that devoting resources for staff training would increase the project's change readiness whether this training was face-to-face, web-based, on-the-job or self-paced. In other words, professional development should have an integral role in an organisation's effort to establish a change management system.

Arain & Pheng (2006) developed a Knowledge-based decision support system (KBDSS) to ensure proper management of project changes. This system formed a database through extracting data from 79 institutional building projects located in Singapore in addition to relying on questionnaire surveys, interviews and rigourous literature review. One of the major advantages of this system is that it could be useful in training new staff members joining the project team (Arain & Pheng, 2006). Bubshait *et al.* (1999) pointed out the importance of assuring that change triggers induced through errors should be prevented through the training of the professionals undertaking the project activities. Similarly, through studying the context of change order management in the Saudi construction industry, Alsuliman *et al.* (2012) realised that offering workshops and training courses to the project team would contribute majorly to comprehending how the organisational change management systems work and implemented.

Alnuami *et al.* (2010) also recommended that a database should be created by the government and to be used by contractors. This database should contain change management data, information and best practices to secure a well informed process for the management of change in the construction project (Alnuami *et al.*, 2010). As per the questionnaire survey conducted in that research, the participants believe that this practice is very beneficial for project change management. Alnuami *et al.* (2010) further suggested that the database could contain data about soil, underground services and weather conditions to provide the involved stakeholder with the advantage of taking informed decisions. Such action would provide a good basis for valuable planning and increase change preparedness of the project team.

It is also critical to properly review the contract standards prior to signing them to assure a smooth and clear change management process. Contract standards generally manage change through variation clauses (Murdoch & Hughes, 2002). These contractual clauses are important to allow the parties to integrate project changes without imitating a new contract (Ndihokubwayo and Haupt 2008). Without a variation clause, the client willing to integrate project changes would have to create a new contract for which the contractor's approval is needed (Murdoch & Hughes, 2002). Therefore, these contract clauses preserves the owner's right to implement changes in addition to providing a guideline to manage the change in the project (CII, 1990). A variation clause allows the contractor to be reimbursed for any additional works induced due to new client requirements or even the incident of a force majeure (Egan *et al.*, 2012). A case study shows that following a systematic approach of documenting the additional costs by the contractor resulted in the full reimbursement in the construction of an electric power plant. Having a specific change clause and fully understanding the contract requirements in the contract highly contributed to regulating the process of managing change (Egan *et al.*, 2012).

Variations are clearly defined in several contract standards that are used in the construction industry. The Fidic Red book shows that variation is change to the works which were instructed or approved as a "variation" while the JCT shows that variation is a change in the employer's requirements for the alteration or modification of the design, quality or quantity of the works. Variation clauses frequently use "change" or "alteration" to the work in contract standards in order to eliminate any chance of reimbursing the contractor for work that is required under the original scope of the contract (Sergeant & Wieliczko, 2015). Without these clauses, the contractor does not have any obligations to adapt any new client requirement no matter how important or value adding it is in the client's perspective (Murdoch & Hughes, 2002).

When it comes to Kuwait, Duaij *et al.* (2007) referred to contract variation clauses as the only route to altering the signed contract and satisfy the emerging client requirements in the Kuwaiti construction industry. The Kuwait Society of Engineers (2001) proposed a contract agreement that enables the client to add or remove project works with ht value of 15% of the original contract value or 25% of any particular working package with denying the right of the contractor to object on this requirement. When it comes to Ministry of Public Works, any variation order that exceed KD 100,000 should be reviewed and approved by Audit Bureau before being admitted to the project. This requirement includes addition or omission of works (Al Duaij *et al.*, 2007). Additionally, the Central Tenders Committee has to approve the variation orders with values more than 5% of the total contract value. The Public Authority for Housing Welfare also uses a contract with similar constraints.

3.3.2 Identifying change

Identifying change is the second stage to manage change in the project (CII, 1994). At this stage, efforts would be in place to identify any deviations to the project aspects that were previously agreed upon in the project contract. A contractual agreement should be viewed as the project baseline through which any deviation should be observed and acknowledged by the stakeholders.

Good communication should be endorsed in the project and would contribute to the identification of change (CII, 1994). Proper communication of project deviations would facilitate an early understanding of the potential change effects at the earliest instance possible (CII, 1994). It facilitates the discussion between the project team members and allows for knowledge exchange thus improving the chance of properly managing the arising change. Intently describing the details and scope of the encountered change would facilitate the change evaluation process later on in the project (Alaryan *et al.*, 2014; Douglas, 2009; Kartam, 1996; CII, 1994). Team building and promoting team spirit also plays a big role for successful communication between the project team members (CII, 1994). The importance of communication was stressed by Douglas (2009) when stating that passing on information concerning the project changes between the owner, contractor and architect is vital for adapting changes in a timely manner.

Chen *et al.* (2012) observed the need for efficient information exchange in the construction industry of Taiwan and concluded that stakeholders use rather basic methods in communicating change related information including telephones and faxes. In response, the researchers developed a web project-based change management (WPCM) system that transmits real time information about project changes in order to overcome communications deficiency. This system previews project change information in a structured manner to allow sufficient communication between the project team members through a portal which requires an online connection. The WPCM system succeeded in increasing the ability of the project team to manage change as shown in a case study (Chen *et al.*, 2012). The case study indicated a satisfaction score of 83% by the contractor using the system (Chen *et al.*, 2012). The contractor also indicated that the system was able to convey realtime information and facilitate access to change records through a friendly user interface. Additionally, the case study clearly indicates that training is an integral part of using the system therefore endorses the significance of properly preparing the team to identify changes in the early stages of the project.

A formal process that enables change prediction should be documented in a clear representation such as a flow chart and improved when required (CII, 1994) where a proactive approach is needed to identify change as early in the project as possible. A research conducted by Motawa *et al.* (2007) focused on the development of a model that predicts the possibility and impact of change occurring in the project using fuzzy logic. The utilisation of the information available at the beginning of the project determines the stability of the project (Motawa *et al.*, 2007). The model developed by Motawa *et al.* (2007) looks into how changes are triggered by different factors and how these factors are interrelated. These factors collectively could have a different effect on the project that would be different from the effect of each change trigger occurring in an isolated manner. In order to deal with the vagueness introduced by the possibility of different combinations of change triggers, Motawa *et al.* (2007) used fuzzy logic.

This approach excels when little information is available and representing the human perspective concerning change causes and effects. For instance, the degree of change trigger and change effect could be understood by this fuzzy-based model thus allowing different severity levels of change influences to be simulated. This entire prediction is facilitated through generating IF-THEN fuzzy rules that define the consequence of each change factor. The development of these rules requires the exploration of change factors and change effects relationship in the project thus would improve the planning process and result in a more robust project planning phase. The stability of each project activity would eventually contribute to a highly stable project where changes would occur less frequently. Therefore, model would potentially contribute to minimising the impact of change on the project through the prediction and preparation of countermeasures accordingly. Nonetheless, the limitation of this model was that it was not tested through real case study to observe its effectiveness and credibility in predicting project changes. The practicality of the model implementation requires verification.

Monte Carlo Simulation is another widely accepted method to evaluate the risk of change on the project parameters. This quantitative risk analysis technique (PMI, 2003) was used by Zhao *et al.* (2010) to analyse the change possibility (CP) and change scope (CS) of the change events in the project. Another method was described by Hajarat & Smith (1993) which utilises a risk analysis technique to provide project managers with updated information about cost and time during the construction phase of the project. This information is presented through an exposure envelope which could be used as a quantitative assessment of the cost and time variations in the project. The exposure envelope is generated through plotting three curves that are generated from the theoretical time/cost curve. The first curve being the optimal minimum cost solution, the second is maximum cost solution and the third being the actual chronological sequence of the project activities. Different curves are simulated through the usage of crashing activities based on the project constraints. This concept was used in conducting case study involving the River Coquet bridge project in order to evaluate the different options for variation and their subsequent effect on cost and time. Hajarat & Smith (1993) concluded that this approach is able to convey a logical framework for appraising different variation options thus support the decision making process.

3.3.3 Evaluating change

Change evaluation is one of the most critical stages in the change management process as improper evaluation may result in a ripple effect. Therefore the project team should follow a systematic path in observing and properly evaluating the potential consequences of the change in the decision making process. Consideration of the change effect is of ultimate importance in the change evaluation process (CII, 1994) and taking the opinions of subject matter experts is absolutely vital to ensure a rigourous decision making process

(Alaryan *et al.*, 2014). Project changes should be regularly reevaluated to calibrate for any deviations in the previous expectations, constraints or assumptions (CII, 1994).

The evaluation process is different when encountering a required or elective change (CII, 1994). The evaluation process of the required changes is different and more pressing than elective changes. Ibbs *et al.* (2001) stressed on the need to seek immediate approval and funding for required changes to prevent any escalation in the associated costs. CII (1994) also pointed out that the evaluation of the required change effect should be done in parallel with its implementation to avoid time or cost implications. On the other hand, elective changes should undergo a more rigourous evaluation process prior to its integration in the project as elective changes are proposed to improve the project but are not vital to its completion (CII, 1994). A formal and diligent evaluation and change justification process is usually associated with proper cost and time estimation in the project (Hao *et al.*, 2008). This change should also be appraised against the the project business drivers (Hao *et al.*, 2008; Zou & Lee, 2008) economic aspects, project success factors, change effects on diverse project areas (CII, 1994) and the value added to the project (Ibbs *et al.*, 2001). There should be a balance between taking a decision as soon as the change is properly evaluated and avoiding rushing into judgment in the evaluation process as rapid decisions result in misjudgment and negative ripple effects in the project (CII, 1994).

Different tools and practices can be used to evaluate the project change. The use of earned value management is also recommended through the literature in order to predict the performance of the construction project and detect any deviations from the expected performance. The BS 6079-1:2002 standard defines earned value management as an efficient and influential method that is used for monitoring and controlling projects. Mortaji *et al.* (2015) used earned value management (EVM) to predict the final project cost and duration in addition to the identification of the change event that triggered these cost and time variation. EVM is used as an indicator of the project performance through utilising key parameters including planned value (PV), earned value (EV) and actual cost (AC) as shown by PMI (2013). Moreover, the usage of change point analysis would detect if a change event has occurred to the project and at which point it occurred. The concept of EVM and change point analysis were combined by Mortaji *et al.* (2015) to develop a model which was used in a case study that involves a medium residential construction project. Mortaji *et al.* (2015) concluded that this approach could be beneficial in both a retrospective and prospective point of view. The retrospective analysis would be beneficial in achieving continuous improvement through understanding the causes of change while the prospective provides the final project cost and duration through accurate analysis as shown in the case study. Most importantly, the case study shows that this approach is useful throughout the construction phase of the project in order to predict any performance variations and proves the applicability of this method.

Ibbs *et al.* (2001) previewed a particular criterion for admitting or disregarding an elective change. The authors proposed using a predefined benefit to cost (B/C) ratio to either accept or refuse the change. In other words, the proposed change should be accepted if it implies additional costs but will eventually convey higher benefits in the project. Ibbs *et al.* (2001) confirms that the cost of change is higher the later it is implemented in the project thus achieving a higher B/C ratio and a more stable project.

The evaluation process can also be supported by different models and support systems to enable a successful decision making process through utilising quantitative and qualitative criteria (Motawa *et al.*, 2007). Engineering software can also be used to identify the possible reflection of this change on the cost and time in addition to evaluating different options based on the software output (Hao *et al.*, 2008). Arain (2008) developed an IT-based change management system that evaluates changes in the project before its implementation. This system considers the change's nature (type) and impact on the project. The impact evaluation is represented by both the time and cost implications of the studied variation. This study mainly focused on the role of IT approaches could represent an important opportunity to learn from previous projects to enable better change evaluation and anticipation of its potential implications. The system was not investigated for its validity in the research conducted by Arain (2008) thus case studies should be conducted to observe this system's applicability. It is worth mentioning that there are limitations with these existing change prediction systems. For instance, the measurement of the cost that could incur due to change is highly inaccurate in some studies since cost overruns could be caused by different factors that may include yet not exclusive to project change (Farbarik, 2004).

A prediction system should be built through a systematic approach that utilises objective information from previous projects. Moreover, some factors are evidently unpredictable in the project (Ibbs *et al.*, 2001) thus change readiness in the project team should be the target (Almaraz, 1994) rather than attempting to predict each and every change event in the project. Clearly, the level of effectiveness of the prediction systems has yet to be determined through case studies and close observation.

Construction project activities have been mistakenly perceived as static which leads to schedule and cost issues in construction projects (Lyneis *et al.*, 2001). This is the basis of using the system dynamics (SD) to predict and evaluate the attributes of changes in the project and act as a beneficial planning and controlling tool (Park & Peña-Mora, 2003). Williams (2003) defined system dynamics (SD) as a quantitative analysis technique that is built on the use of cause mapping and feedback. The usage of a dependency structure matrix (DSM) for change prediction has been pointed out by Steward (1981) to establish and represent the dependency between the project activities through a matrix representation. This matrix contains the input and output information for the project activities and clarifies the prerequisites for the project activities to start (Browning, 2001).

DSM utilises the information flow to limit the effects of change through the prediction of the change's ripple effects as mentioned by Zhao *et al.* (2010). Therefore it is a method used to simulate the processes occurring after a change event based on analysing the interconnectivity of the project activities. In SD, cause maps are developed through interviews and workshops to illustrate the change triggers and effects and how these events are interrelated with each other (Williams, 2003). Additionally, Eden *et al.* (2005) added that an SD computer simulation model attempts to imitate the negative influences of delays in the project. SD within the change management scope is primarily used to preview the change event trigger, the party responsible and illustrate the time and cost implications of the change (Williams, 2003). This would highly contribute to the support of the claims as pointed out by Williams *et al.* (2003). Park & Peña-Mora (2003) developed a dynamic project model that captures the feedback processes in construction as a step of evaluating the change effects on time throughout construction.

This model targets the analysis of intended and unintended changes influence on the project and illustrates the change impact on project duration based on the change type, discovery status and time (Park & Peña-Mora, 2003). It has been used in a case study which is a bridge renovation project. It was concluded from this study that SD would support the construction managers in evaluating project changes during the construction phase and prevent non-value adding or even detrimental changes from being approved into the project. Eden *et al.* (2005) on the other hand focused on the usage of SD in the evaluation of both cost and time effects of changes in the project.

More precisely, the research scope was to highlight the advantages of using SD in settling cost and time disruption claims in the construction projects. It is compulsory to extensively research the possible events that could cause change in the project in order to fully comprehend the nature and dynamics of the project (Eden *et al.*, 2005). The SD model developed should take into consideration "what if" simulations to illustrate how different scenarios would affect the project costs (Eden *et al.*, 2005). Even though the usage of SD targeted the accommodation of the complex environment of the construction project, this technique is also criticised for its shortcomings. The first shortcoming is that SD models will not normally operate at the operational level of the project network (Williams, 2003). Additionally, SD assumes a steady productivity in the project activities thus do not represent solely the discrete event of change.

A simpler method is more frequently used in the construction industry to evaluate the effects of change events on the project schedule and is known as the critical path method (CPM). This method represents the basic approach to evaluate the impacts of change events on the project schedule in theory yet lacks the effectiveness in reality. Williams (2003) adopted this point view through discussing that project schedules are theoretically built at the beginning of the project and frequently differs from the as-built situation. The cause of this difference is that as the project stages proceeds, fresh contingencies arise causing the actual "critical path" of the project to be questioned and updated regularly. This route in applying the CPM would cause the loss of correlation between the baseline schedule and the actual project. Bordoli & Baldwin (1998) added that the effectiveness of the CPM method in dealing with a delay related claim is to prepare and continuously update an as-planned schedule, as-built schedule, owner-accountable schedule that contain delays caused by the client and finally adjusted schedules.

CPM is criticised in the literature due its simplistic views on variations in the project. The first issue with CPM is that when there are many disruptive effects, the activities could be affected simultaneously in a way that creates new interrelationships between these activities (Williams, 2003). Moreover, the study conducted by Williams (2000) indicated that CPM also fails to properly assess the implications of change since it assumes that there is no managerial reaction to the events influencing the project. In other words, CPM disregards the actions taken by management to remedy the project thus assumes that management will stand still and simply monitor the project get affected by the change without taking executing any gestures to improve the project performance. It is therefore recommended that the combination of CPM and SD would be beneficial in introducing the benefits of the systematic modelling of the SD to the operational models provided by the CPM (Williams, 2003).

The use of Building Information Modelling (BIM) is currently spreading in the construction industry due to the range of benefits provided by BIM. These benefits include the facilitation of the change management process and specifically, change detection and evaluation. Langroodi & Staub-French (2012) studied the applicability of BIM in managing project changes. The main scope of work focused on recognising project changes through checking the documentation stored in the BIM model and detecting any alterations. This method is successful in observing any alterations to the original model and its correlated effects. For example, if a change in the design is applied, the correlated effect would be observed instantaneously in the BIM tool through checking the updated project documentation such as quantity bills and schedules. This would reflect the implications of the design change which is crucial for approving or declining design changes (Alaryan *et al.*, 2014). Additionally, the ripple effects would be controlled through identifying how one element is connected to the other thus noticing how a change in this element affected the surrounding environment.

Nonetheless, this process is fixated on the post-change stage and contributes to managing changes after they are adapted in the BIM model. This approach does not facilitate a change evaluation process for changes that are not interconnected with the project. Additionally, there is no knowledge management system that would facilitate a continuous improvement process. Liu *et al.* (2014) also studied the effects of introducing change management through BIM in the construction projects. This research is a part of the BIM data hub project which targets the development of a central repository of information in order to facilitate the management of change. Liu *et al.* (2014) developed a framework that embeds change management into BIM. The framework seeks to connect BIM with the integrated change and knowledge management system (CKMS) developed earlier by Liu *et al.* (2013) with an emphasis on the change management discipline.

Change requests are managed in the CKMS starting with a change evaluation and if it is approved, the change information will be synchronised with the BIM server.

On the contrary of the approach adopted by Langroodi & Staub-French (2012), this approach facilitates information flow between stakeholders to enable enhanced project change evaluation. More importantly, the framework developed by Liu *et al.* (2014) enables the automated process that updates any changes to the BIM model. Nonetheless, this system has yet to be developed completely and it is still a concept that requires implementation and validation through actual case studies. It is clear from the previous segments that BIM could be highly helpful in integrating a method of project change effects evaluation. These effects could be potentially observed in different aspects such as effects on cost, time and design.

The role of the contractor is extremely important when it comes to the change evaluation process. Douglas (2009) points out that it is the responsibility of the contractor to study the impact of the proposed change on cost and time prior to issuing a change order request. The contractor should provide a change order request package including relevant and supporting documents to the client with the purpose of justifying the need and consequence of the proposed change (Douglas, 2009). If the change is approved after being adequately evaluated, a change order would be produced and should describe the impact of change on project schedule and cost in addition to an action plan for implementing and monitoring the change (Hao *et al.*, 2008). The change should be then implemented and properly monitored within the project.

3.3.4 Implementing and monitoring change

One of the most important steps in the change management system is the implementation of the change itself. Change implementation includes change authorisation documentation and tracking (Chen *et al.*, 2015; Hao *et al.*, 2008; CII, 1994). Proper documentation is absolutely vital in the change implementation stage (Chen *et al.*, 2015; Arain, 2008).

Gaining the necessary approval is the most critical step in this phase of managing change (Alaryan *et al.*, 2014). Formally permitting change follows the efforts have been done to study and evaluate the proposed change and its implications on the project. The authorisation also implies that all relevant stakeholders have been informed about the change and agree on its implementation (CII, 1994). The process of formally authorising changes in the project should be enforced by the contract agreement. The project team would commit to implementing changes upon formal approval rather than mere verbal instructions to avoid any consequent issues such as refusal of payment by the employer (Anees *et al.*, 2013).

Through a questionnaire survey that targeted contractors, consultants, designers and others as project managers and investors, Anees *et al.* (2013) attempted to evaluate the efficiency of the change management practices in the Egyptian construction industry. 73% of the survey respondents agreed that the contractor should not proceed with implementing any change if there was no official written change order. The respondents also indicated that special contract clauses could be present to allow verbal change orders under specific conditions and for urgent changes only (Anees *et al.*, 2013). Nonetheless, Douglas (2009) Elaborated on the same concept and declared that the contract agreement should allow minor variations orally to mention the project progress. Douglas (2009) added that a formal change order should subsequently confirm a former verbal order when applicable to grant the relevant stakeholder's right. It is quite clear that this approach could be beneficial in urgent situation.

Change documentation was also mentioned under the main components of the change implementation as shown by CII (1994). Documentation provides a route to overview the updated cumulative impact of the changes on the project. Such an effort would facilitate an appropriate status update for the change and enables the team to control it more effectively (CII, 1994). The change documentations may include original change cost estimation, photographs, site investigation report, plans, contract, legal documents, engineering calculations, QA/QC records, daily reports, procurement records, purchasing records, project correspondence, equipment assignment and use records, cost and financial reports, meeting minutes, time sheets, schedules and requests for information (Egan *et al.*, 2012). Such documentation could also be provided at the end of the project to improve the organisational knowledge and build a foundation for continuous improvement.

The system proposed by Chen *et al.* (2015) necessitates the use of diverse highly descriptive documentation templates including a change document, change record sheet, change breakdown structure, change matrix and a change control sheet. Each and every document plays a specific role in the implementation of change in the project. The change documents contains information about the change topic, date and time of proposal, the initiator, manager, stakeholders affected, coordinator, change description and necessary attachments. On the other hand the change record sheet that previews the interactions and discussions between the stakeholders on the platform such as requesting clarification, discussing the financial implication of the change, …etc. Additionally, the change breakdown structure illustrates the taxonomy of the change and which activities are being affected. Chen *et al.* (2015) proposed a change control sheet which shows the change cause, imitator and status of each change in the project. Chen at al. (2015) also pointed out the importance of sharing information in to enable change tracking within a web environment. Through the utilisation of a case study, this proposed documentation system received a high evaluation when it comes to sharing and accessing change information in the project, improve change monitoring, easier change records retrieval and reduce the possibility of repeated mistakes.

3.3.5 Continuously improving from lessons learned

Continuous improvement is the phase of the change management where the knowledge and experiences of managing changes are reviewed and shared by the project team. The continuous improvement process should run from the beginning till the completion of the project, even include employing experiences gained in the previous projects (CII, 1994). A robust documentation system highly contributes to the continuous improvement of the change management system. CII (1994) recommended that continuous improvement of the change management capabilities is achieved through establishing and developing project metrics.

Change management related metrics should indicate the extent of success in achieving a specific activity in the process of change management (CII, 1994). Metrics could be used by the project team as a benchmarking technique that objectively evaluates the degree of success offered by the management of change induced costs and set the foundation for comparison between different projects. Zou & Lee (2008) developed a change cost metric through their research to evaluate the cost variations in the project. The usage of this specific metric was suggested by CII (1998) by dividing the costs of change over the actual project cost. This ratio was specifically developed since Zou & Lee (2008) the Construction Industry Institute Benchmarking and Metrics database and attempted to compare between the cost of change performance between the available projects based on the indices shown in the database. On this basis the absolute value of change orders are not comparable but the developed metric could actually provide an insight to highlight any patterns of successful change management practices whether individually or collectively contribute to improved change cost performance.

3.4 UTILISING CHANGE MANAGEMENT PRACTICES AND TOOLS

The previous section highlighted a high range of practices and tools that were studied in the literature and applied in the construction industry to manage project change. The review showed how these practices and tools can be grouped in different stages to manage change.

A combination of practices and tools can be used in the successful management of project change. Nonetheless, there seems to be a lack of focus on which practices and tools are the most suitable for usage by contractors in the Kuwaiti construction industry. Even if discovered, a system is required to ensure the capability of the contractor in managing project changes through observing the integration of these successful practices and tools and providing tangible and measurable evidence of the contractors readiness for change management (Sun *et al.*, 2009).

To fulfil the objective of comprehending the organisation's management abilities and adjust accordingly, a Capability Maturity Model (CMM) can be used (Paulk *et al.*, 1993). CMM is a framework that represents a path of improvements which is tailored to the organisations that aim to enhance their domain specific capabilities or universal maturity (Paulk *et al.*, 1993). Using CMM correctly could potentially yield positive outcomes as it would ensure that the contractor is on the path of applying the necessary change management practices and tools that are needed for better project outcomes. On this basis, the next chapter will explore the spectrum of available CMMs and highlight the possible outcome of using CMMs to achieve the research objective.

3.5 SUMMARY

This chapter explored the change management practices and tools as featured in the literature to fully understand the different facets of managing project change. A focus was given on the different practices and tools used within different change management stages including promoting a balanced change culture, identifying change, evaluating change, implementing and monitoring change and finally continuous improvement. A range of change management approaches within these stages was deeply reviewed in order to understand their strengths and weaknesses. As a result, there seems to be a big range of change management practices and tools yet no research focusing on these method's suitability and effectiveness if potentially used by contractors in Kuwait. Therefore, this research will be set to explore the most suitable options for contractors in Kuwait and establish a model to ensure their proper and consistent integration. The next chapter will be dedicated to reviewing and comparing numerous capability maturity models in the construction industry and systematically appraising the capability maturity models approaches and structures as shown in the literature.

CHAPTER 4 - CAPABILITY MATURITY MODELS

4.1 INTRODUCTION

The previous chapter explored the change management practices and tools that are presented in the literature. Even though a wide spectrum of processes are used to manage change, negative change effects are still influencing the project outcomes within the Kuwaiti construction industry. An effective approach is needed to systematically ensure that the correct and effective processes are implemented and standardised within the contracting company to manage change. This approach would evaluate the capability of the contractor to conduct the change management process properly and highlight the necessary process improvement.

For this purpose, this chapter will review the most popular and successful capability maturity models which are presented in the literature as a step to find how the change management capability of contractors is measured and possibly improved. The structure of these models will be deeply explored and compared to preview how these models function and what they could possibly contribute to the achievement of this research's objectives. The review will start with Capability Maturity Models that are related to the construction domain in general followed by the models that focus on the change management capability in specific.

The Capability Maturity Model (CMM) concept was first developed by the U.S. Department of Defense, Software Engineering Institute (SEI) in Carnegie Mellon University as a method to objectively evaluate the ability of government contractors to perform military software projects in the 1980s. The CMM was originally a framework for managing software process improvement activities (Persse, 2001). Even though CMM initially targeted the software industry, it has been fruitfully used in different process areas. This evolution was triggered on the basis that CMM proved its robustness and applicability beyond the software industry. This concept has evolved into a framework of process improvement models known as Capability Maturity Model Integration (CMMI). This framework currently includes CMMI development (CMMI-DEV), acquisition (CMMI-ACQ) and services (CMMI-SVC).

These different frameworks cover different process areas based on the strategy and requirements of the organisations. For the purpose of this study, the CMMI-DEV was deeply explored since the objectives cover the development and implementation of change management in the project. On this basis, the 22 process areas forming the CMMI-DEV was highlighted in conjunction with the other process areas of the other CMMs reviewed. The initial conceptual basis of CMMs was conceived by Crosby as a step to evaluate quality of organisational processes (Crosby, 1979) under the umbrella of total quality management (Brookes *et al.*, 2014) and strategically targets continuous improvement through understanding the current and required position of the organisation and optimising organisational processes accordingly (Cooke-Davies *et al.*, 2001). The majority of CMMs are based on the Plan-Do-Check-Act cycle of Deming (1993) as pointed out by Mullaly (2014).

CMM is a framework that represents a path of improvements which is tailored to the organisations that aim to enhance their capabilities (Paulk *et al.*, 1993). Gottschalk (2009) adds that CMMs represent theories behind the stage by stage improvements of the organisational capabilities along a desirable maturity path. PMI (2003) also defined maturity models as a structured collection of elements and terms describing attributes of process, product, and organisation. Wendler (2012) realised that a clear and concise definition of CMMs is frequently avoided in the literature and researchers tend to preview descriptions and functions of the models instead. This was concluded after systematically reviewing 237 articles addressing the capability maturity model approach in diverse domains including the construction industry. This perspective is clear in the literature since there is a conflict of generalised definition of the CMM and facilitates a systematic approach for benchmarking, performance appraisal and optimisation in the organisation. This framework is designed to provide a good engineering and organisational management practices that would be suitable for any project environment (Hafeez,1999). This target is obtained through a structure that breaks down each level to different process areas which requires the achievement of particular practices for each area, provide guidance on how these practices could be achieved and appraise current practices. This structure would assure the achievement of business objectives through improving the conducted processes and staff capabilities (Humphreys, 1992). CMMs help in evaluating the strengths and weaknesses of the organisation in order to improve the conducted processes and achieve higher organisational maturity and enables benchmarking performance across diverse organisations (Khoshgoftar & Osman, 2009; Kohlegger *et al.*, 2009).

CMMs assume different perspectives of growth. Some models focus on describing the stages of progress while the other models focus on the description of the potential performance resulting from maturing in the organisation. The first perspective is known as life cycle perspective and the latter known as potential performance perspective (Wendler, 2012). The lifecycle perspective focuses on the evolution of the organisation over time and satisfying all the stages by integrating improvements and based on previous experiences as shown in the model developed by Nolan (1979).

On the other hand the models using the potential performance perspective focus on the benefits delivered from gaining a specific maturity level and its desirability based on the organisational needs as show in the model developed by Crosby (1996). McBride (2010) points out that the majority of the models offered in the literature resort to the potential performance perspective. Nonetheless, the suitability of using either one of these perspectives should be based on the need of the organisation and the purpose of the model itself. If the organisation is seeking a tool that can be used for improving a specific area it would be better to use a model with a life cycle perspective since stages of improvements are defined in an enhanced manner. To the contrary, if the organisation is using a model with the potential performance perspective, the organisation has to choose the most suitable level of maturity for the situation as every stage has its benefits as pointed out by Kohoutek (1996).

There seems to exist an actual issue of the lack of standard terminology usage within the CMMs available in the literature. This issue was addressed by Wendler (2012) who criticised that the concept of capability maturity model is known as either maturity model, capability model, process improvement model, maturity grid, competency model or excellence model even though these concepts are different as per the guidelines presented in the CMMI. CMMs are also known as stages of growth models, stage models or stage theories in various sources of literature (Rajteri, 2010). Other differences present in the used terminology is related to the structure of these models.

CMMI recognises that maturity levels include practices for distinct process areas that enhances the performance of the organisational. These maturity levels are achieved through achieving these specified collection of practices and gaining maturity in a group of process areas required by the maturity level itself (CMMI Product Team, 2010). On the other hand, P2MM perceives that maturity levels could focus on each and every process area in an isolated approach without specifying groups of process areas needed for maturing as presented in the CMMI. These specific levels used in P2MM are named as capability levels rather than maturity levels (CMMI Product Team, 2010). The main difference is that capability levels focus on specific areas of concern of the organisation and work on organisational growth within that scope while the maturity levels take a holistic approach that ensures the overall progress of all the processes used in the organisation. Similarly, CM3 uses “maturity levels" even though these levels take the same approach of the “capability levels” in CMMI.

Nonetheless, even though CMMs may have different terminologies, it is more important for these models to have distinct levels that represents a logical progression in the organisation (De Bruin *et al.*, 2005). These models can be compared in every aspect if a unified terminology was adopted within this research. Wendler (2012) pointed out that CMMI is the most widely addressed and popular model throughout the literature of CMMs based on a systematic review of 237 article. On this basis, the terminologies used in the CMMI will be used as a guideline for comprehending and explaining terms used in other CMMs for the review presented in the following sections. On this basis, the following sections shall deeply review the fundamental components of the widely recognised CMMI in order to comprehend the main blocks of a capability maturity model. Next, CMMs that were developed specifically for the construction industry were reviewed followed by a review for change management CMMs to explore the value added by these models and understanding how these models were developed. This would highly enrich the research methodology and assist in building a robust foundation for developing a change management capability maturity model in the upcoming chapters.

4.2 CMMI FUNDAMENTAL COMPONENTS

Essentially, all the CMMs are based on two main components which are improvement representations and improvement criteria (Wendler, 2012). Improvement representation refers to the levels used to indicate maturity in the models and improvement criteria is the prerequisites of a specific level of growth (Wendler, 2012). The following subsections shall break down these main components and explore how the popular CMMI model functions.

4.2.1 Improvement representations

There are two improvement representations mentioned in the Capability Maturity Model Integration (CMMI) which allows the organisation to achieve different objectives. The first representation in the CMMI is the staged approach which necessitates the availability of predetermined process areas to achieve a certain maturity level in the organisation. Maturing in this representation requires achieving improvements across multiple process areas. This representation would also indicate which process areas are necessitated to achieve the next level of maturity in the organisation. Gaining improved organisational maturity secures the stability of the established processes and improved predictability for the organisational process outputs.

The second representation is the continuous approach which closely observes each process area and assigns an individual score to represent the organisation's capability in that specific process area. This representation would provide the organisation with a more detailed look into its capability within a particular process area improving it without being overwhelmed with improving the entire range organisational processes. In other words, the continuous approach targets incremental and more manageable improvements for specific areas of concern within the organisation. This representation is connected to the term "capability level" to indicate the progress in a specific knowledge area within the organisation. It is also worth mentioning that various models provide the organisations with both the continuous and staged representation of improvement to allow for the freedom of choosing whether a holistic improvement is needed in the organisation or is it only improvements within specific process areas.

CMMI Product Team (2010) presented figure 4-1 to illustrate how the staged representation and the continuous representation are different when it comes to the path of process improvement. The primary difference is that the continuous representations measures improvement in each process area within a specific module while the staged representation measures improvement in multiple preset process areas in the organisation. Nonetheless, to promote terminology standardisation, CMMI uses similar level numberings in both representations when they carry the same significance. This is represented by using similar terms between capability levels 2 and 3 with maturity levels 2 and 3.

The CMMI Product Team (2010) endorses the idea of improvement whether it was by utilising the continuous or staged approach in the organisation. This comes from the perspective that the driving force in organisational brilliance is the improvement itself rather than its representation. The capability and maturity levels as presented in the CMMI are deeply reviewed in the following section to further understand what constitutes these improvement levels.

Both improvement representations use different types of levels for process improvement. The staged representation uses maturity levels which focus on the overall growth of the organisation amongst different knowledge areas while the continuous representation uses the capability levels which fixate on a particular knowledge area for improvement (CMMI Product Team, 2010). As shown in table 4-1, the levels used are different in both representations where the continuous representations uses capability levels that ranges from 0 to 3 while the staged representation uses maturity levels that ranges between 1 to 5.

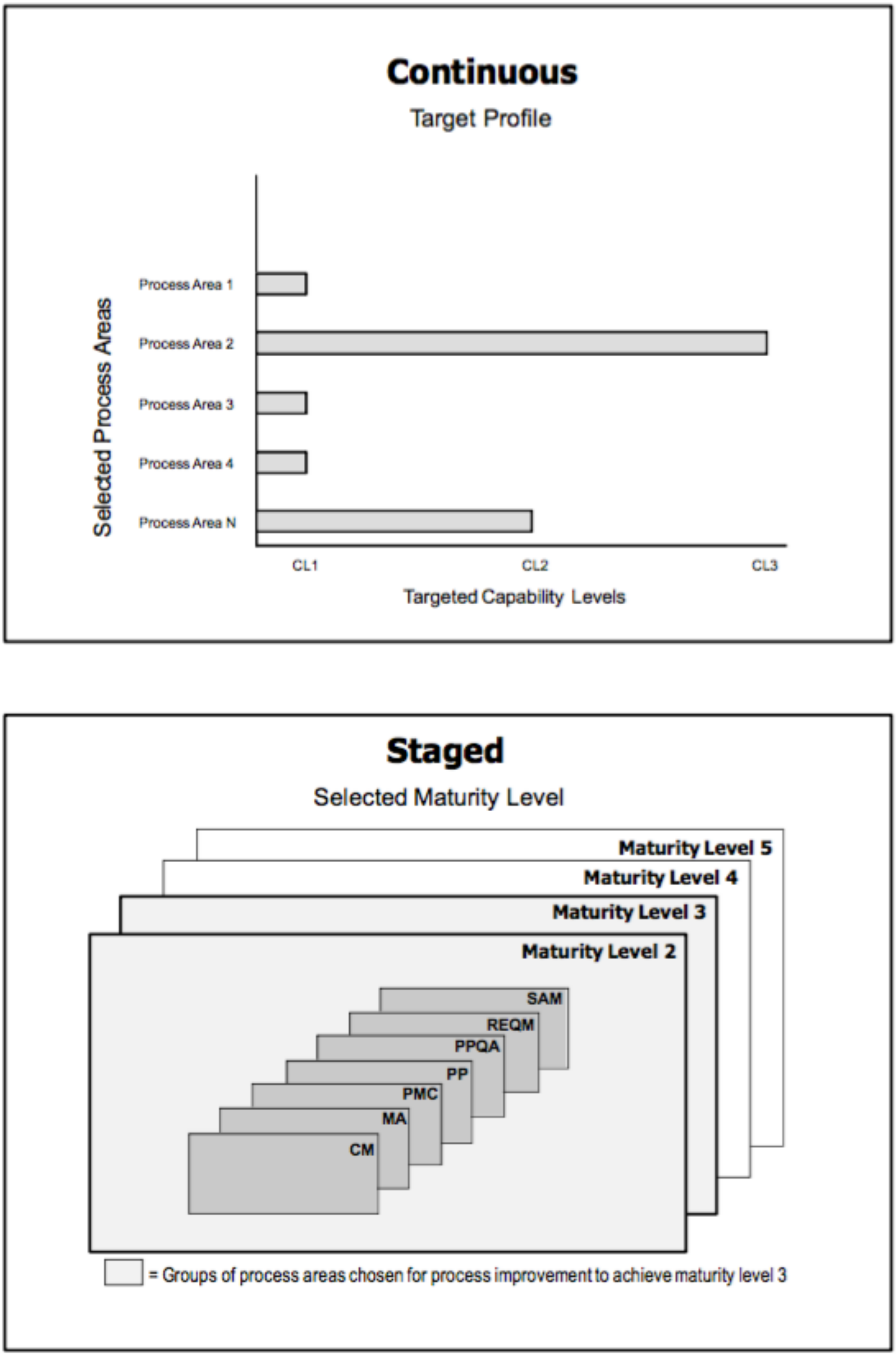

Figure 4-1 Process Areas in the Continuous and Staged Representations

Table 4-1 Capability Levels vs. Maturity Levels

Level	Continous Representation (Capability Levels)	Staged Representation (Maturity Levels)
Level 0	Incomplete	-
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4	-	Quantitatively Managed
Level 5	-	Optimising

Gaining a specific maturity level is based on implementing the practices of the relevant process areas. Process areas are clusters of a collective practices that when implemented achieve goals that subsequently trigger improvements in this process area. CMMI includes 22 process areas that are needed to achieve maturity in the organisation. Maturity levels are be explained next to highlight how these levels are portrayed in the path of overall organisational improvements.

Maturity Level 1 - Initial

This level indicates a chaotic process and ad hoc management basis in the organisation. This environment does not secure stability in the organisation needed to ensure proper processing. Accordingly, achieving positive process outcomes is arbitrary and built on the competence of the organisation team rather than the utilisation of evidently effective processes. Even though ML1 organisations are tagged with chaotic processing, the project outputs could be functional yet frequently does not satisfy the time and cost constraints. Since the processes are ad hoc, repeatability of a successful process is not a feature of ML1 organisations. Additionally, CMMI Product Team (2010) points out that ML1 organisations tend to abandon the organisational processes in times of crisis.

Maturity Level 2 - Managed

This level indicates a level where projects follow a policy to plan, execute, monitor, review and assure process compliance against process description. Process success is repeatable in this maturity levels a pointed out by Sowden *et al.* (2008). Process outputs are also controlled through assuring that the project team are equipped with the skills, knowledge and resources to complete this task. To the contrary of ML1, ML2 organisations establish processes that assure that practices are retained throughout the time of crisis which allows adequate project management and a sufficient performance (CMMI Product Team, 2010). ML2 organisations also provides adequate attention to the work products status and are produced against descriptions, standards and procedures. ML2 organisations additionally assures that stakeholders commitments are clearly defined and reassessed when required.

Maturity Level 3 -Defined

This level indicates properly defined processes which are based on organisational set of standards, procedures, tools and methods to achieve consistency and standardisation amongst the organisation and are prone to refinement over time (CMMI Product Team, 2010). On the project level, these organisational processes are tailored to the needs of the project according to specific tailoring guidelines. Tailoring the organisational processes to fit the project needs represents the main difference between ML2 and ML3. Processes are only standardised in each project but different form one project to the other in ML2 while these processes are institutionalised across all the projects in the organisation and are customised against preset tailoring guidelines. For instance, these standards could be modified based on the project nature, cost, involved stakeholders… , etc. Additionally, ML3 organisations take a proactive approach to manage the process, interrelationships of process activities and product (CMMI Product Team, 2010).

Maturity Level 4 - Quantitatively Managed

This level indicates that the organisation defines a criteria based quantitative objectives representing the client and relevant stakeholders needs to manage the quality and project processes performance. Quality and process performance is managed statistically throughout the project life cycle (CMMI Product Team, 2010). It is also a good practice to utilise process performance baselines to generate the quality and process performance objectives that would in return assure that business objectives are gained. Predicability if project processes and performance through quantitative control is what sets ML4 from ML3 organisations (CMMI Product Team, 2010).

Maturity Level 5 - Optimising

This level is where the organisation utilises the quantitative comprehension of organisational requirements to continuously improve the established processes and optimise the process outputs. This improvement is achieved through incremental process standards and technology enhancements in the organisation (CMMI Product Team, 2010). Improvements to the organisational performance are driven by the need to adapt to the dynamic business objectives. These improvements are quantitively measured to verify its influence in achieving performance objectives. Improvements in ML5 is on the organisations level to the contrary of ML4 which focuses on minor project enhancements due to understanding and controlling the process performance. The organisation rather focuses on data derived from a collective of projects to be analysed thus highlight the performance shortfalls on an organisational level. These gaps of performance set the path of organisational process improvements that qualitatively contributes to boost the overall performance of the organisation.

On the other hand, CMMI Product Team (2010) defines capability levels as a route for incremental to the processes correlated with a specific process area. progressing in capability levels is set according to a specific sequence in the CMMI. This sequence involves the achievement of specific goals and practices in addition to generic goals and practices in the organisation. This will be thoroughly discussed in the following sections. The following section will look into the meaning of the capability levels as illustrated in the CMMI to provide insight to what constitutes capability levels.

Capability Level 0 - Incomplete

This level indicates that a process is either partially not conducted or not conducted at all. The process at this level is not consistently used throughout different projects within the same organisation.

Capability Level 1 - Performed

This level indicates that the process is properly conducted and goals expected are achieved accordingly. Improvements could be present in this level but not institutionalised thus these enhancements could vanish on the long run.

Capability Level 2 - Managed

This level indicates that the process is planned and conducted in accordance to a set of policies. Additionally, this level shows that the people have the required skills and resources to control the process outputs (CMMI Product Team, 2010). Institutionalisation takes place in this level thus the process improvements could be rationed over time. CL2 in process area also entails that the stakeholders commitments are established and reviewed when required.

Capability Level 3 - Defined

This level indicates that the process is tailored based on a present organisations standards and according to tailoring guidelines. The process has a clear maintained description and contributes to the standardised organisational processes improvements. CL3 provides consistency among project processes in comparison with CL2 excluding the modified parts of the process according to the organisational tailoring guide utilised for each project. Additionally, CL3 takes a proactive approach in comparison with CL2 processes with increased predicability and control of the process output.

The natural process progression in both the staged and continuous improvement representation offered by CMMI sets a good path to duplicate for other models. Moreover, the purpose and meaning behind using either ML's or CL's should be considered prior to developing any model and depending on the model's objective.

4.2.2 The Improvement Criteria

The previous section discussed the different representations of improvements presented in diverse CMMs. These representations requires different criteria in evaluating the organisational levels of growth. The staged approach depends on specifying certain process areas for certain levels while the continuous approach depends on satisfying a cluster of process areas for a specific module only. This section will explore how the improvement criteria is connected to the levels of growth used in the CMMI and in other models.

The maturity models improvement criteria is dependent on the dimensions used in the model which covers both subjective and objective metrics for organisational competence (Hihn *et al.*, 2011). These dimensions are the different components of the organisation that would influence its main business conduct. Lyytlnen (1991) points out that dimensions could include processes, organisational units, domains, … etc. These dimensions could also be used for benchmarking and appraisal activities (CMMI Product Team, 2010). The CMMI model specifies that the maturity/capability would eventually measure three critical dimensions which would make a multidimensional model. These dimensions are people, procedures and methods, and tools and equipment. The CMMI

Product Team (2010) stresses on the processes ability to dictate the route of conducting businesses in the organisation. The CMMI Product Team (2010) also points out the importance of people and technology yet claims that focusing on the organisational processes will ensure that organisation is functioning at the optimum capacity using these resources.

The CMMI Product Team (2010) defines a process area as a cluster of practices that satisfies a set of goals when implemented collectively would contribute to improving that specific area. Therefore to satisfy these process areas, the organisation should look into the practices needed to be conducted. CMMI Product Team (2010) clearly states that progressing in the maturity and capability levels is based on satisfying the generic goals and practices and specific goals and practices. The definitions for these terms as featured in the CMMI are as follows:

Generic Goals (GG)

> A model component that describes the needed characteristics to institutionalise the processes that implement a process area.

Generic Practices (GP)

> The practices needed to achieve the associated generic goal.

Specific Goals (SG)

> A model component that describes the unique characteristics needed to satisfy the process area.

Specific Practices (SP)

> The practices needed to achieve the associated specific goals.

To progress in the maturity and capability levels, the completion of particular GG's and GP's is necessary. CMMI offers three levels of generic goals including GG1: Performed Process, GG2: Managed Process and GG3: Defined Process. The staged representation requires the completion of GG's for certain process areas to proceed to the next maturity level. For instance to proceed to ML2, GG2 needs to be achieved in specific process areas. When it comes to the continuous improvement representation, CL0 indicates that some of the process area SP's are conducted but not entirely thus the SG that depends on conducting these practices collectively is not achieved. Conducting all the process areas

SP’s would take the process to CL1 which means that the SG’s are achieved in addition to automatically gaining GG1 that simply requires achieving all the specific goals for the process area. CL2 is dependent on achieving all the process area SG’s in addition to GG1 & GG2 which focuses on institutionalising the performed processes. Finally CL3 is dependent on achieving all the process area SG’s in addition to GG1, GG2 & GG3 thus secure a defined process. Table 4-2 summarises the capability levels connection with the GG’s, GP’s, SG’s and SP’s as featured in the CMMI model.

Table 4-2 CMMI Capability Levels Criteria

Level	GG’s	GP’s	SG’s	SP’s
CL0	-	-	-	√
CL1	GG1	√	√	√
CL2	GG2	√	√	√
CL3	GG3	√	√	√

4.3 CMM’S RELATED TO CONSTRUCTION

This section will explore the available CMMs in literature which are oriented towards the construction industry. Sun *et al.* (2009) presented a table that includes the abbreviations and sources of CMMs in the construction industry as a part of their literature review. This table has been expanded to include CMMs that are recently developed and was arranged chronologically in table 4-3. It is clear that the efforts to develop construction industry related CMMs is widespread in the literature. These CMMs cover different disciplines such as project management, portfolio management, program management, facilities management, risk management, value management, infrastructure management and change management.

When looking intently at the these models and their functions, there seems to be a slight yet common misusage of terminology by when it comes to the model’s improvement representation in capability maturity models presented in the literature. Various developed models tend to use the terminology maturity level to describe the continuous representation used in the presented capability maturity model. For instance, Sun *et al.* (2009) developed the CM3 which measures the project change management capabilities. When observing CM3, it is clear that the model takes the continuous approach of improvement representation to measure the organisation’s ability to manage change. Nonetheless, Sun *et al.* (2009) used the term “maturity level” to describe the path of improvement in the model which is not accurate according to the definition of the CMMI Product Team (2010). In other words, the term "capability level" should have been used to describe the continuous improvement representation which was adopted in CM3. On this basis and to avoid any vagueness or terminology misunderstanding, this research will commit to using the terms "maturity level" and "capability level" in alignment with their original definition as mentioned by CMMI Product Team (2010).

Table 4-3 Capability Maturity Models in the construction industry

Name	Abbr.	Author	Objective	Improvement Representation	Levels
Programme Management Maturity Model	PMMM	PMI (2001)	Project management maturity	Staged	ML1: Initial process ML2: Repeatable process ML3: Defined process ML4: Managed process ML5: Optimised process
Structured Process Improvement Framework for Construction Environments – Facilities Management	SPICE FM	Construct IT (2001)	Project management maturity for organisations handling facilities management only	Staged	ML1: Initial ML2: Service delivery management ML3: Knowledge management ML4: Quantitatively controlled ML5: Continuously improving
Organisational Project Management Maturity Model	OPM3	PMI (2003)	Project, program and portfolio management maturity	Staged	ML1: Standardise ML2: Measure ML3: Control ML4: Improve
Project Management Process Maturity Model	$(PM)^2$	Kwak and Ibbs (2002)	Project management maturity	Staged	ML1: Ad-Hoc ML2: Planned ML3: Managed at project level ML4: Managed at corporate level ML5: Continuous learning
Portfolio, Programme and Project Management Maturity Model	P3M3	OGC (2006)	Project, program and portfolio management maturity	Staged	ML1: Awareness ML2: Repeatable ML3: Defined ML4: Managed ML5: Optimised

PRINCE 2 Maturity Model	P2MM	OGC (2006)	Project management maturity (for organisations which adopted the PRINCE2 management method)	Staged	ML1: Awareness of process ML2: Repeatable process ML3: Defined process ML4: Managed process ML5: Optimised process
Standardised Process Improvement for Construction Enterprises	SPICE	SCRI (2005)	Project Management (focused on tendering, design and construction)	Staged	ML1: Initial/Chaotic ML2: Planned & tracked ML3: Good practice sharing ML4: Quantitatively controlled ML5: Continuously improved
Infrastructure Management-Process Maturity Model	IM-PMM	Zeb *et al.* (2013)	Infrastructure Management	Staged	ML1: Infancy ML2: Preliminary ML3: Reactive ML4: Proactive ML5: Integrated
Risk Management Maturity Model	RM3	Zou *et al.* (2010)	Risk Management	Staged	ML1: Initial ML2: Repeatable ML3: Managed ML4: Optimised
Risk Management Capability	RMC	Mu *et al.* (2013)	Risk Management	Staged	ML1: Initial ML2: Repeatable ML3: Managed ML4: Optimised
Value Management Maturity Model	VM3	Karim *et al.* (2014)	Value Management	Staged	ML1: Initial process ML2: Repeatable process ML3: Defined process ML4: Managed process ML5: Optimised process
Prosci's Change Management Maturity Model	-	Prosci (2004)	Change Management	Staged	ML1: Ad-Hoc or Absent ML2: Isolated projects ML3: Multiple projects ML4: Organisational standards ML5: Organisational competency

Change Management Maturity Model	CM3	Sun *et al.* (2009)	Change management	Staged	ML1: Ad-hoc change management ML2: Informal change management ML3: Systematic change management ML4: Integrated change management ML5: Continuous Improvement in change management
Change Management Capability Maturity Level	CMCML	Arowosegbe & Mohamed (2015)	Change Management	Staged	ML1: Ad-Hoc or Absent ML2: Isolated projects ML3: Multiple projects ML4: Organisational standards ML5: Organisational competency

Program Management Maturity Model (PMMM) was developed by PMI (2001) and is set to focus on the standards and practices of project management. OGC (2006) points out that PMMM assists the organisations in managing projects and enhance the possibility of better outcomes and decrease the possibility of negative risks affecting the project. Demi & Kocabaş (2010) also pointed out that conducting optimum project management practices would be reached through inducting PMMM.

Structured Process Improvement Framework for Construction Environments – Facilities Management (SPICE FM) targets the performance of activities that would embrace the constructive management of built assets. SPICE FM is a process improvement framework that focuses not the construction organisations according to (Finnemore, 2000). Standardised Process Improvement for Construction Enterprises (SPICE) focuses on a single phase, different phases or the organisation as a whole. SPICE is based on the European Foundation for Quality Management/Business Quality Foundation-Business Excellence Model (EFQM/BQM) standard (Hutchinson and Finnemore 1999). This model could be applied to either an individual organisation or the entire supply chain in the construction industry as pointed out by Sarshar *et al.* (2000). SPICE primary assists the organisation in acknowledging its strengths and weaknesses and determine the necessary process improvements programs needed in the organisation (Zeb *et al.*, 2013).

Organisational Project Management Maturity Model (OPM3) has more than 500 best practices and several thousand underlying capabilities (Crawford, 2011) and is structured on the basis of the Project Management Body of Knowledge (PMBOK) standard (PMI, 2003). This model focuses on introducing proper project management in the organisation through comprehending the established organisational processes, evaluating their strengths and weaknesses and proposing refinements. (Zeb *et al.*, 2013) adds that OPM3 is also used in appraising the organisation's portfolio and program in addition to the project level. Nonetheless, this model is criticised for its over complexity. This perspective is based on the fact that OPM3 uses various directories in the assessment and improvement process which requires staff training and requires overseeing by a project management office as pointed out by Alami *et al.* (2015).

The Project Management Process Maturity Model (PM2) integrates a quantified systematic approach to higher maturity through identifying and evaluating project management practices and performances as pointed out by (Kwak & Ibbs, 2002). This model is focused on establishing proper project management in the organisation through a systematic and disciplined approach Backlund *et al.* (2014).

Portfolio, Programme and Project Management Maturity Model (P3M3) is a framework that sets the path to organisational process improvements on the portfolio, program and project level (Zeb & Froese, 2011). Karim *et al.* (2014) claimed that promoting value for money and augmenting organisational standards is what sets P3M3 aside from the remains CMMs.

PRINCE 2 Maturity Model (P2MM) is derived from the P3M3 and is known as a standard that provides a framework to assist the organisations in implementing PRINCE2 and improve the organisational practices based on the industry best practices (Graham, 2011). This model can be used for organisations that took the choice of using PRINCE2 as project management method rather that the Project Management Maturity Model.

Other models focusing on risk management were developed as shown in the literature including Risk Management Maturity Model (RM3), Risk Management Capability (RMC) and Project Risk Management Maturity (PRMM). This models were developed with the purposed of raising the organisational ability to limit the damaging effects of project risks. Moreover, a Value Management Maturity Model was developed by Karim *et al.* (2014) in order to increase the value for money delivered to the client from the project.

Additionally, Infrastructure Management-Process Maturity Model (IM-PMM) was developed by Zeb *et al.* (2013) to benchmark the existing maturity of work methods and communications within the domain of infrastructure management. Project management maturity is measured along three dimensions known as knowledge, attitudes and actions as shown by Andersen and Jessen (2003). The knowledge dimension is concerned with having the ability to conduct tasks in the project. The attitude dimension is concerned with the organisational willingness and commitment to conducting the proper practices. Finally the actions dimension is concerned with actually integrating these practices by ht organisation.

OPM3 on the other hand defines around 600 best practices that should be implemented in association with two dimensions to achieve the highest maturity level. The first dimension being the association between the best practices and its progression in terms of standardisation, measuring, controlling and continuously improving. The other dimension needed for growth is related the association between the best practice and the domains including project management, program management and portfolio management.

Dimensions including culture, process, experience and application has been adopted by the Risk maturity model (RMM), Risk Management Maturity Model (RMMM) and the Business Risk Management Maturity Model (BRM3). Hartono *et al.* (2014) also used these specific dimensions and specified sub dimension for each and every dimension during the development of an empirically verified project risk maturity model (PMMM) for the Indonesian construction industry. A total of 13 sub dimensions were converted to questionnaire items in order to indicate the maturity of the organisations along these dimensions.

Zeb & Froese (2011) also developed the IM-PMM based on three dimensions (process, actor role, and information definition) to assess work processes maturity and an additional dimension (message definition) to assess communication processes maturity. On the other hand, another criteria is used to progress in the maturity levels in the P3M3 model. The model requires the integration of 32 key process areas (KPA's) as shown in figure 4-2. Similar to the CMMI, each maturity level has particular KPA's that needs to be satisfied in order to gain that level. Interestingly, ML1 which is considered a chaotic level (OGC, 2006), requires that the organisation to satisfy KPA's 1.1 & 1.2 to the contrary of CMMI that assumes that no process area is established in ML1. There is no reference in P3M3 to a specific structure that would assist the organisation to mature from one level to the other. The model only delivers a description of the expected organisational performance at each maturity level. This approach may be related to the perspective of growth adopted by P3M3.

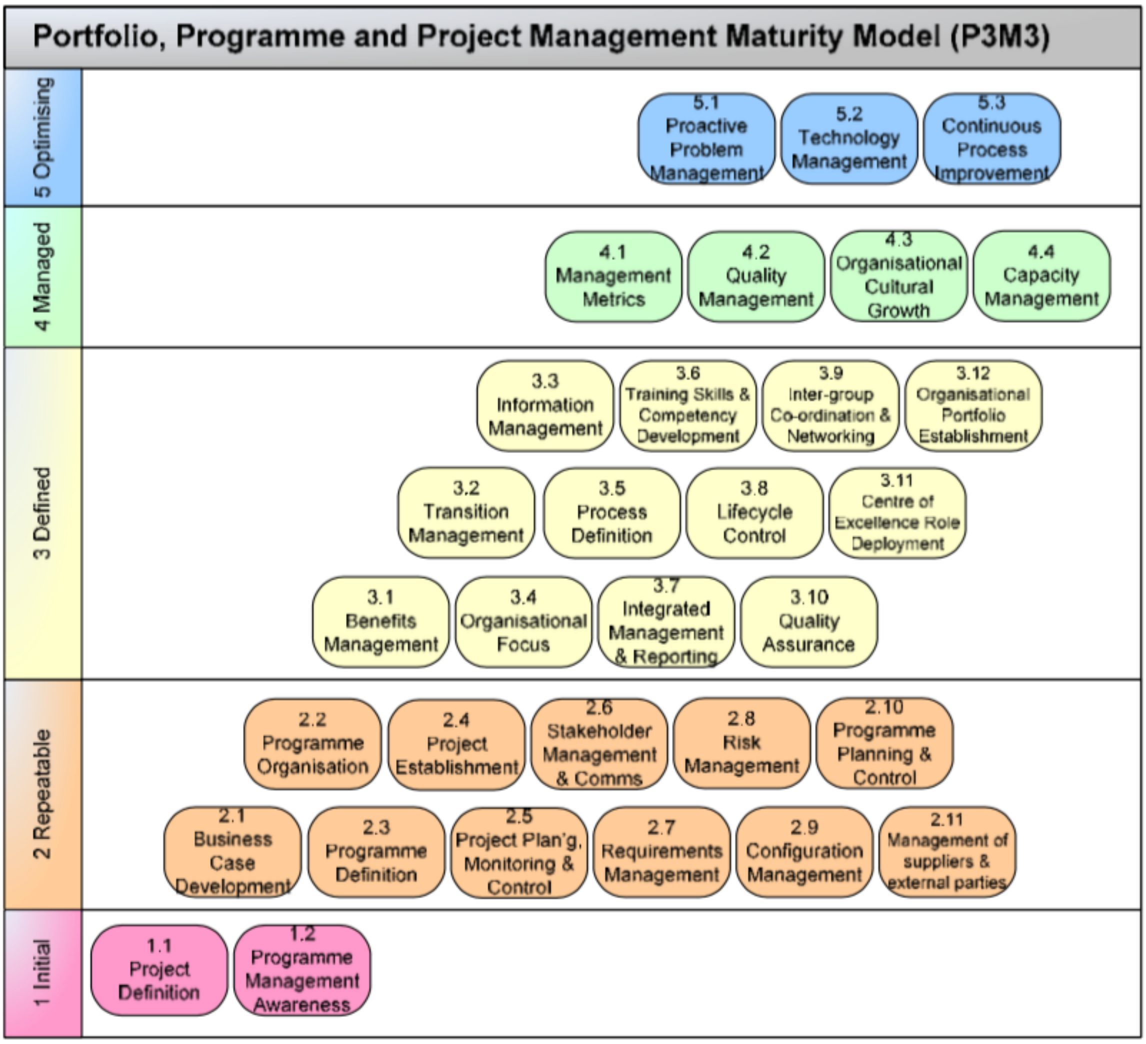

Figure 4-2 P3M3 Maturity Levels Criteria

OPM3 is considered another model that uses the continuous representation. Nonetheless the criteria used in OPM3 is entirely different from the one adopted by CMMI. OPM3 deals with 5 process groups which are initiating processes, planning processes, controlling processes, executing processes and closing processes. Gaining maturity in these process groups necessitates conducting best practices.

These best practices are formed by one or more capabilities of the organisation in order to be conducted properly. Moreover, Key performance indicators (KPI's) are used in the determination of the validity of the outcomes expected from the capabilities and how it compares to the evidence collected in the organisation. These indicators are either quantitative or qualitative depending on the criterion itself. Tangible evidence should be presented to satisfy these KPI's wether these evidences are quantitative or qualitative (PMI, 2003). The maturity representation in OPM3 takes several forms. These forms can be used to provide the organisations with different illustrations of maturity. Figure 4-3 represents the continuum of maturity depending on best practices implementation. Another form is the spider that is use to indicate the induction of best practices in the three domains of project, program and portfolio management as shown in figure 4-4.

Figure 4-3 OPM3 Organisation's relative maturity

It is also worth mentioning that OPM3 is set in alignment with the Project Management Book of Knowledge (PMBOK) which would highly encourage its integration into the construction industry since it is aligned with one of the most established project management standards. PMBOK which was developed by the Project Management Institute (PMI) is one of the most endorsed and integrated body of knowledge in the Kuwaiti construction industry. The comprehensive terminologies, processes and guidelines presented in the PMBOK within several project management domains are strictly followed by a wide spectrum of contracting companies in order to optimise the project outcomes.

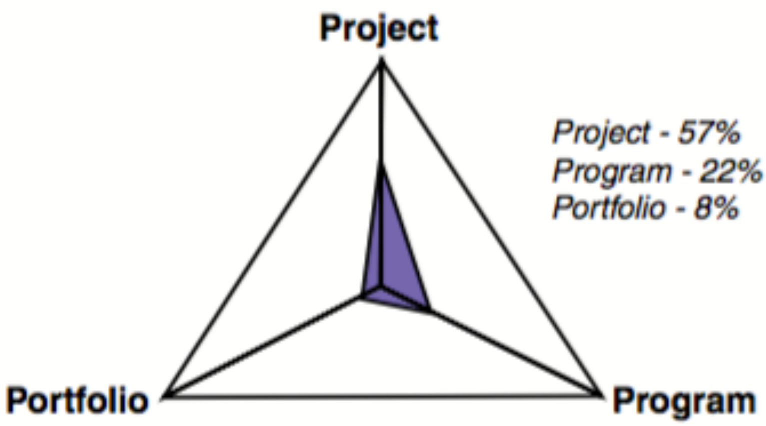

Figure 4-4 OPM3 Spider Diagram showing maturity in each domain

Clearly, the building blocks of capability levels for these models are different but the end result is typical. This result is a simple indication of the capability level of each process area under study. As clearly indicated CMMs use different process areas according to the objective of the model. Different improvement representations are used in the models available in the literature. Table 4-4 clarifies the naming of the different maturity levels used in the CMMI and P3M3 models.

Table 4-4 Levels in CMMs using the staged representation

Model	ML1	ML2	ML3	ML4	ML5
CMMI	Initial	Managed	Defined	Quantitatively Managed	Optimising
P3M3	Initial	Repeatable	Defined	Managed	Optimising

As shown, both the CMMI and P3M3 models provide the user with 5 levels of maturity starting with ML1 to ML5. On the other hand, even though the maturity levels are clearly arranged according to natural sequence of organisational maturing, OPM3 does not offer specific numbering for the maturity levels. OPM3 uses relative maturity to represent the organisation's continuum towards maturity. This approach (and other approaches to maturity) will be discussed later on in this research when comparing the structures of CMMs.

Capability levels are used to illustrate organisational improvements when using the continuous representation. Table 4-5 clarifies the naming of the different capability levels used in the CMMI, CM3 and P2MM models. Nonetheless, this section will focus on the CMMI representation only whereas the other models will be reviewed in the following sections.

Table 4-5 Levels in CMMs using the continuous representation

Model	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
CMMI	Incomplete	Performed	Managed	Defined	-	-
P2MM	-	Awareness	Repeatable	Defined	Managed	Optimised
CM3	Ad-hoc Change Management	Informal Change Management	Systematic Change Management	Integrated Change Management	Continuous Improvement in Change Management	-

When observing capability levels in different models, it could be realised that the variances in the meaning of each capability level. A contributing factor is the fact of using different structures in these models which makes impedes the comparison between these levels even though these levels should essentially address similar factors in all the models. This perspective is backed up by De Bruin *et al.* (2005) when stating that CMMs are currently developed without conducting sufficient research to understand the current status of these models designs. In other words, a lot of these models tend to reinvent the wheel rather than building up on the momentum of previously established models.

The same issue of variance in structure used reoccurs in P2MM. The levels used to indicate improvements in the process areas in an isolated manner. This isolated focus on the areas is the reason P2MM was considered under this section for review. This approach is indicated as the one shown in the continuous representation that uses capability levels. To the contrary, P2MM uses maturity levels to indicate the maturity of each area of focus. This is where difference of terminologies personifies the issue of compatibility between these models even though the target and approach employed is similar between the two models.

SPICE also takes a similar path in assessing organisational growth levels by using 5 maturity levels that are also dictated by achieving competence of 14 KPA's. Each level is assigned to a set of KPA's to be completed except ML1 which indicates the chaotic execution of processes and unpredictable performances in the organisation.

P2MM uses maturity levels to evaluate the level of seven process areas of project management as shown in figure 4-5. Even though the growth is measured in an isolated manner for each and every process area, P2MM uses the term "maturity levels" which conflicts with the terminologies of the CMMI. In other words, the approach used by P2MM and the measurement approach is actually using CL's rather than ML's but the use of different terminologies would give the reader an incorrect indication of the improvement representation adopted.

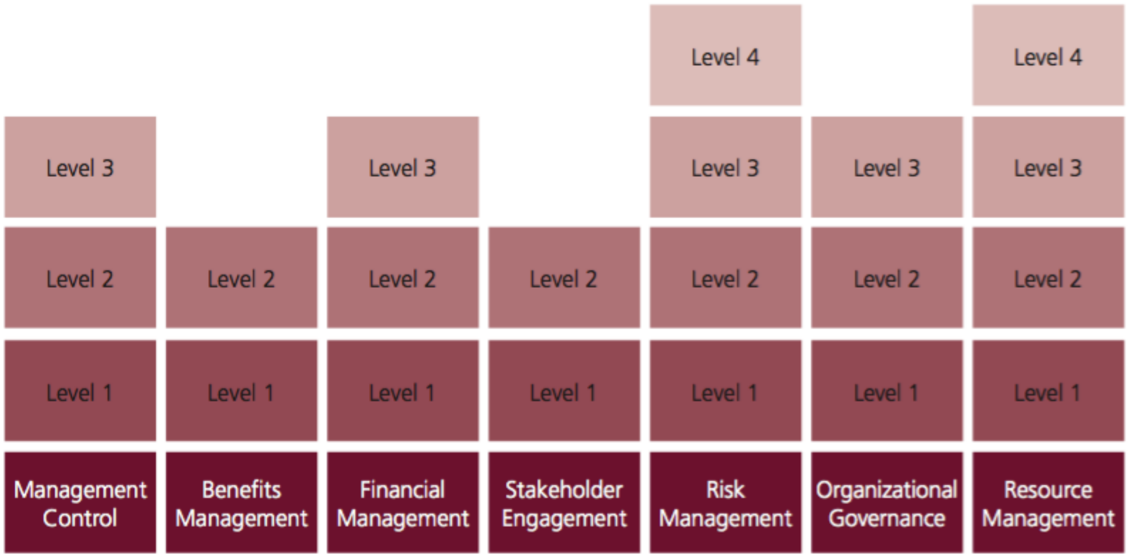

Figure 4-5 P2MM Maturity Levels

OPM3 on the other hand chooses another approach to showing the organisational growth level by abandoning the concept of "stages" and using an overall growth progress indication known as the organisation's relative maturity. It is essentially up to the organisation to conduct approximately 600 best practices in order to eventually gain optimum maturity according to (PMI, 2003). Conducting these practices contribute to standardising, measuring, controlling and continuously improving the organisational practices on a project, program and portfolio level.

4.4 CMM APPRAISAL PROCEDURE

The appraisal procedure is an examination of one or more processes by a trained team of professionals using an appraisal reference model as the basis for determining, at a minimum, strengths and weaknesses (CMMI Product Team, 2010). It is a method of evaluating the best practices undertaken in the organisation and the corresponding capabilities (PMI, 2003). Conducting appraisals contributes to determining the organisation's processes competency in accordance with a particular CMM and allows the replication of results rather than having the risk of varying appraisal outcomes (Valdés *et al.*, 2011).

When exploring the literature, it could be recognised that various appraisal methods are offered by different CMMs. Since this research aims to eventually produce a capability maturity model, these methods should be closely observed in order to choose the most suitable approach that would yield proper and reliable outcomes.

For organisations intending to conduct appraisals for the CMMI should be aware that these examinations should be set in conformance to the Appraisal Requirements for CMMI (ARC) according to (CMMI Product Team, 2010). The ARC offers different types of appraisal known as the Standard CMMI Appraisal Method for Process Improvement (SCAMPI) to evaluate the CMMI integration in the organisation. Moreover, ARC offers different options when it comes to SCAMPI with varying depth of conformity investigation known as class A, B and C appraisal methods.

SCAMPI A is the most thorough appraisal method while SCAMPI B and SCAMPI C are more simple and less formal (CMMI Product Team, 2010). Choosing the suitable method is dependent on the purpose of the appraisal and the surrounding constraints in the organisation itself. The appraisal in OPM3 otherwise known as "Assessment" is based on one path only to the contrary of the CMMI which offers different routes of assessments. This assessment is offered in different phases starting with the self assessment then focusing on the detailed assessment of the best practices, capabilities and maturity progress of the organisations integrating OPM3.

SPICE offered an alternative method of assessment in order to examine the maturity of the organisation. This method is known as the Balanced Scorecard which is usually used in the context of business appraisal. Finnemore & Sarshar (2002) attempted to link this business tool with the systematic organisational continuous improvement concept utilised in the capability maturity models. A conceptual model was created by the Finnemore & Sarshar (2002) to illustrate how the Balanced Scorecard tool was to provide a wider horizon to the construction organisations in relevance to the business aspect of its operations rather than focusing exclusively on the internal processes. The aspect is quite intriguing when it comes to focusing on the financial side of the construction companies. This tool could be used as a strategic business management tool in the organisation willing to increase its competitiveness and focus on customer satisfaction as a standard throughout its business operations. Finnemore & Sarshar (2002) also points out that the Balanced Scorecard could be enhanced through the integration of the standardised process improvement mechanisms.

Arowosegbe & Mohamed (2015) did not provide explicit details of the phases used in the examination process for CMCML. Becker *et al.* (2009) mentioned that only maturity models providing proper documentation could be compared in research. CM3 "partially" followed the detailed SCAMPI A assessment method presented in the CMMI (Sun *et al.*, 2009). For instance, requirements in SCAMPI A such as team leader credentials and certification were not specifically mentioned in the appraisal requirements of CM3 thus could be one of the reasons behind the partial integration of SCAMPI A. Other models did not particularity specify how the appraisal process was defined such as the VM3 model which was by Karim *et al.* (2014).

Clearly, these appraisal methods utilise similar phases which constitutes planning, execution and result reporting of the organisational maturity/capability as shown in table 4-6. The only exception could be the appraisal method of CMCML. It is clear from the article that there is no mentioning for any planning processes in the examination process. Nonetheless and as previously mentioned, this could be due to the limited detail offered by Arowosegbe & Mohamed (2015) in the article. Another reasons this was not emphasised that the research conducted by Arowosegbe & Mohamed (2015) focused on the development of a conceptual model and its validation by a group of experts rather than using a case study and showing the particular phases of assessment.

Table 4-6 Appraisal phases in CMMs

	Appraisal Phases		
SCAMPI A	Plan & Prepare for Appraisal	Conduct Appraisals	Report Results
SCAMPI B	Plan & Prepare for Appraisal	Conduct Appraisals	Report Results
SCAMPI C	Plan & Prepare for Appraisal	Conduct Appraisals	Report Results
OPM3	Prepare for assessment	Self & Comprehensive Assessments	Checklist Results
CMCML	-	Asses CMC Level	Produce CMCML Report

Since common grounds were found between these appraisal methods, the upcoming sections reviews these methods based on the three mutual phases which are the planning and preparation, conducting appraisal and results reporting. The phases chosen will ensure the full coverage of the appraisal processes detected in these CMMs.

4.4.1 Planning and preparation

This section will review the steps put into place in the planning and preparation phase prior to undertaking the appraisal in the organisation. This phase will include all the processes conducted before the start of the appraisal process.

SCAMPI A, B and C all recognise that preparing for the appraisal should include analysing, requirements, developing an appraisal plan, selecting and preparing the team, obtaining and retain initial objective evidences and finally prepare for the conducting the appraisal. Objective evidences can be divided to three categories known as direct artefacts (documentation), indirect artefacts (meeting minutes, review results, status reports, … etc) and affirmations (interviews) as shown by the SCAMPI Upgrade Team (2011). The ARC also specifies that the plan content should not be altered without the consent of the sponsors of the appraisal. If these changes were approved, this should be documented in a record.

Even though some requirements are the same between these methods, there seems to be some differences between these classes when looking into further depth. The first difference is that the credentials of the lead appraiser who is responsible for leading the activities of the appraisal process are different in these classes. SCAMPI A shows that the team leader should be a certified by the Software Engineering Institute. On this basis, the lead appraiser should have gained knowledge and skills that are necessitated by the SEI appraisal program. Additionally, the certified lead appraiser should be able to use the SCAMPI Method Definition Document (MDD) which describes the requirements, activities and practices of the SCAMPI method (SCAMPI Upgrade Team, 2011). On the other hand, SCAMPI B & C requires that the lead appraiser is sufficiently trained and experienced in such appraisals.

Nonetheless, these classes of appraisal demands that the credentials of the lead appraiser is satisfactory to the criteria of the specific MDD. This requirement is ensured by the CMMI steward who maintains a program of qualification, training, and monitoring for SCAMPI lead appraisers (SCAMPI Upgrade Team, 2011). The steward simply acts as a coordinator for the appraisal program established in the organisation and ensures that proper processing is conducted.

Another dissimilarity is that the appraisal team formation is a requirement for SCAMPI A & B to the contrary of SCAMPI C that does not require an appraisal team but still emphasises the need of identifying the lead appraiser. Even though SCAMPI A & B both require an appraisal team, there seems to be some commonalities and differences in these requirements. One of the commonalities is that both methods require that the team members participating the appraisal should complete the SEI approved introductory course covering the relevant models included in the scope of the appraisal.When it comes to differences in team formation requirements, SCAMPI A requires that the team is formed of 4 members while SCAMPI B settles for only two members including the team leader in both requirements (Luttrell & Hefner, 2005).

When it comes to OPM3, it is vital to prepare and plan before the beginning of the appraisal phase. It is required that a designated team knows the basic concepts behind OPM3 and organisational project management. The preparation should also include the understanding of the OPM3's narrative text and the content of the three directories included within the standard (PMI, 2003).

4.4.2 Conducting the appraisal

This section will review the steps put into place for the appraisal execution in the organisation. The appraisal execution phase is where the capabilities of the organisation is examined in relevance to the integrated CMM and ultimately to its alignment to the business objectives.

SCAMPI A, B and C all recognise that the appraisal phase should include the preparation of participants, the examination, documentation and verification of objective evidence, validate the initial findings and generate the appraisal results. The ARC specifies particular requirements for the appraisal process that presents some commonalities and differences between the three appraisal methods.

All these methods emphasise the importance of the full involvement of the appraisal team members and establishing a mechanism to determine the validity and sufficiency of the collected data. The data should be deemed to be adequate and in relevance to the scope of the appraisal, using clear terminology and compliant with various aspects. These aspects include the objectivity of evidences that must be derived from credible sources during the data collection session. The traceability of the evidence collected and relevance to the reference model is also essential in this phase.

SCAMPI A & B necessitate that the collected objective evidence from interviews with the organisation practitioners in addition to extracting data from documentation such as policies and procedures. SCAMPI C takes a simpler approach by allowing the appraisal team to extract objective evidence from one source only. This evidence should be verified in SCAMPI A & B but not necessarily in class C. This verification should be through collecting the data from two sources that represents an actual sample of the ongoing procedures of the organisational unit being appraised.

SCAMPI A & B also considers that it compulsory to establish a proper process for the verification of the appraisal findings while this process is optional for SCMAPI C. These findings must be based on objective evidence and consistency is acquired throughout all the findings. In other words no conflicts between these findings should be present which ensures the accuracy of this information. SCAMPI A also requires that the preliminary findings that state the strengths and weaknesses are prepared and validated by the appraisal participants to ensure its reliability and eliminate any ambiguities. The feedback provided may also result in reconsidering these findings or adding new findings as well. This entire process is optional for SCAMPI B & C.

The OPM3 provides the user with three directories known as the best practices, capabilities directory and improvement planning directory. The best practices directory lists approximately 600 best practices that sets the foundation of the model and the basis of the appraisal. Additionally, this directory illustrates how this best practice is correlated with the domains of project, program and portfolio management in addition to the process improvement stages including standardise, measure, control and improve.

On the other hand, the capabilities directory includes organises capabilities on the basis of the correlating best practices. Finally the third directory which is the improvement planning directory is concerned with arranging the capabilities based on priority to establish the best practices. Moreover this directory shows the outcomes expected from each capability. These three directories will be used in this phase of the appraisal process as it will be shown below. OPM3 uses the self assessment and comprehensive assessment in this phase of appraisal. Starting with the self assessment, the organisation would know which best practices are achieved and which ones are missing in relevance to the best practices directory through using a survey. The missing best practices will be considered as a target best practice. This step contributes to providing an overview of the overall compliance with the best practices used in the organisation (PMI, 2003).

These targeted practices should be observed in order to determine which area should be prioritised to proceed to the next part of the assessment. The next step in the OPM3 is the comprehensive assessment which starts with a deeper investigation of the best practices and observes which capabilities are missing with each of the targeted best practices. Each capability should have an outcome and this steps will observe wether evidences present in the organisation is satisfactory to these outcomes. The organisation should comprehend its current location in relevance to the path of maturity and understand what possible improvements are required in conjunction with capabilities directory. This understanding will show if the organisation is willing to continue to the next phase which is planning for improvements based on the available resources and overall gratification of currency maturity position.

CMCML uses a questionnaire survey for the appraisal participants to answer questions concerning the coverage of the capability areas under study. This appraisal is based on comparing the appraisal evidences with the attributes and sub attributes defined in the model.

4.4.3 Results reporting

This section will review the steps put into place for the reporting and recommendation in the organisation. The reporting and recommendation phase is where the capabilities of the organisation are reported and recommendations are made accordingly. These recommendations should represent incremental improvements to the abilities of the organisation and would contribute to the achievement of the organisational objectives.

SCAMPI A, B and C all acknowledge that the delivery of appraisal results phase should provide authentic results that can be used as a frame of reference for the activities taken to implement organisational improvements. Accordingly, these results should show the strengths and weaknesses of the processes appraised. Moreover, it is required in all the SCAMPI appraisal that the findings are documented and reported to the appraisal sponsor. That would be in addition to providing necessary records for the appraisal sponsor as well. SCAMPI A requires the generation of ratings while this task is not required by SCAMPI B & C. An appraisal rating is the value assigned to the process area goals, CL's and ML's in the organisation (SCAMPI Upgrade Team, 2011).

These ratings should be set according to a specific criteria as shown in the ARC document. The rating should be done when the verified evidence are compliant to the data coverage criteria shown in the MDD that defines the minimum evidence collection procedures for process areas, basic units and supporting units in the organisation. The rating of process areas should be sequential to specific and generic goals rating. Moreover, rating ML's should be done by rating the process areas required in this level and the previous levels as well to assure that particular capabilities were preserved in the organisation and is still properly conducted.

Similarly, CL's rating should be based on rating the generic goals required for that specific capability level and the levels below as well. The appraisal team should provide a rating of "satisfied" or "not satisfied" for the specific and generic goals based on satisfactory evidences as per the coverage criteria of the MDD. If this criteria is not satisfied, the goals would then be rated as "not rated". Alternative practices that are as effective as the practices mentioned in the CMMI could be accepted according to the appraisers expert judgement (SCAMPI Upgrade Team, 2011).

OPM3 also considers this phase as a part of the appraisal cycle through using the improvement planning directory as a check lists that reports the outcomes coverage in the organisation in relevance to the established KPI's. Moreover, the organisation can improve its processes accordingly through prioritising the needed improvements by attainability, strategic priority, benefit and cost (PMI, 2003).

CMCML on the other does not define any processes relevant to the reporting and recommendations. Nonetheless, this phase is simply acknowledged by Arowosegbe & Mohamed (2015) through stating the collected data is used in the fuzzy synthetic evaluation to produce a five-level maturity scale to the contrary of the other approaches adopted in CMMI and OPM3 that uses a basic rating system that does not need computerised algorithms. This is considered to be a reporting tool that could be used in communicating the current level of change management maturity in the organisation.

4.5 CHANGE MANAGEMENT CMM'S

The CMMs focusing on change management have limited availability in the literature. This section will set to explore the available models and to illustrate the problems they were set to solve. First, the models will be explored separately to gain a better understanding of how they actually function. Next, the main similarities will be highlighted in addition to emphasising the common gaps in these models.

Change Management Maturity Model (CM3) was developed by Sun *et al.* (2009) to improve the change management process by focusing on the project team and enhancing their necessary skills and knowledge thus increasing the change preparedness in the project. This model was set to achieve this objective through measuring the capability of managing project variations during the construction phase of the project (Sun *et al.*, 2009). Similar to the CMMI, CM3 is a multidimensional model which is built on several dimensions including people, procedures and methods, and tools and equipment.

CM3 uses five levels to determine the maturity of six KPA's which are management process, risk management, communication, management information, collaboration, leadership/objectives. The model uses the maturity grid to evaluate the level of progress in the change management which contains a description of each maturity level in conjunction with the model process areas as shown in figure 4-6. This grid would allow the organisation to identify the maturity of each KPA and act accordingly to improve its change management practice (Sun *et al.*, 2009). The model components were developed through extracting the opinions of industry professionals through questionnaire surveys followed by interviews. Three case studies were also conducted to validate the practicality of the model to the construction industry.

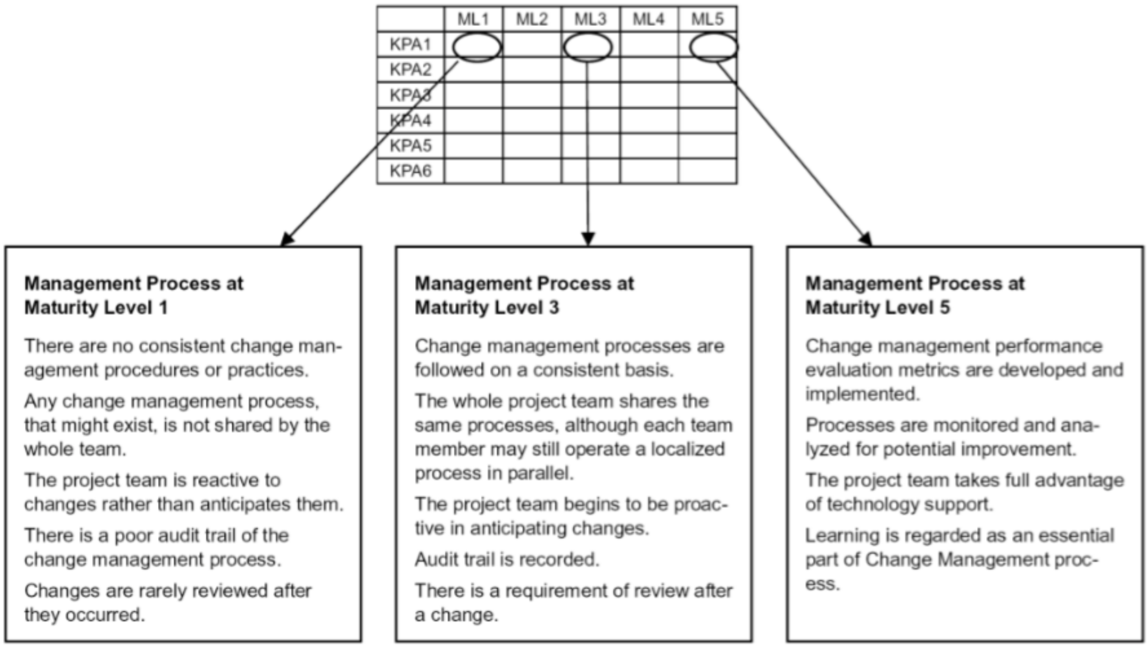

Figure 4-6 CM3 Grid

Similarly, Arowosegbe & Mohamed (2015) developed the Change Management Capability Maturity Level (CMCML) in order to improve the organisation's capability to conduct a proper change management process. This model focuses on systematically assessing the management capability of the organisation in order to mitigate the detrimental effects of project variations (Arowosegbe & Mohamed, 2015). The model was also built on a multidimensional basis similar to the CMMI in addition to also including the identical five maturity levels found in the CMMI (Arowosegbe & Mohamed, 2015).

CMCML was developed through four stages starting with the identification of evaluation factors, assessing these factors, creating the model and finally developing the maturity measure of the model (Arowosegbe & Mohamed, 2015). The key capability areas used in this model included leadership, application, competencies, standardisation and socialisation. These areas would include subprocesses which are related to the proper change management practice as concluded by the extensive literature review (Arowosegbe & Mohamed, 2015). The model includes five different maturity levels which are ML I: Absent or Ad-hoc, ML 2: Isolated project, ML 3: Multiple projects, ML 4: Organisational standard and ML 5: Organisational competency. Each of the five capability area is assessed individually which is computed via fuzzy synthetic evaluation approach (Arowosegbe & Mohamed, 2015) as shown in Figure 4-7.

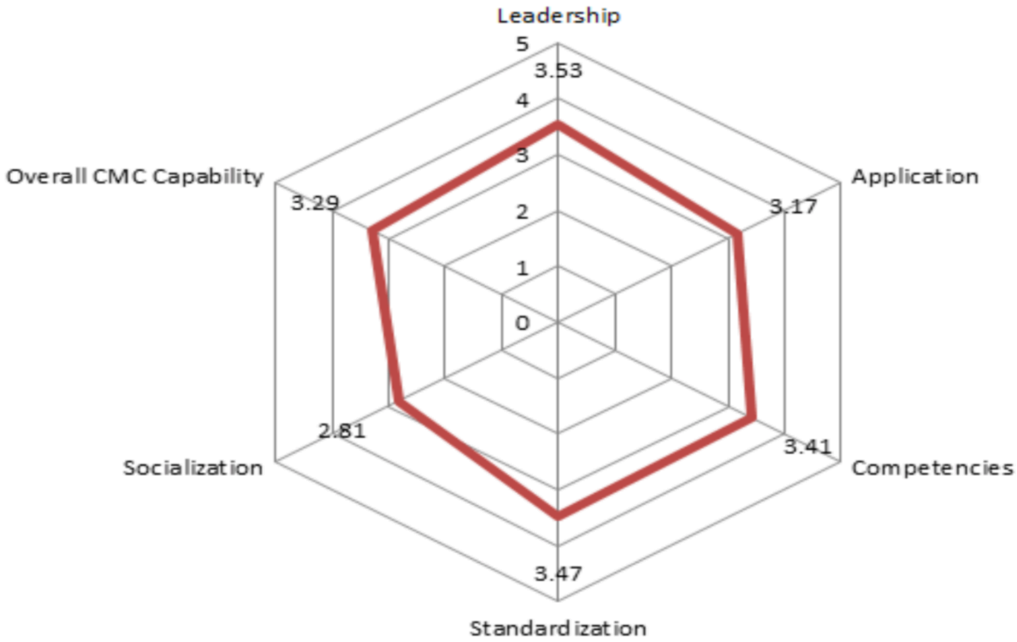

Figure 4-7 CMCML maturity levels and key capability areas

Even though this model was created on the same basis of CMMI (Arowosegbe & Mohamed, 2015), it is unclear how the maturity levels used in CMCML emerged as they are not similar to the ones mentioned in the CMMI and Arowosegbe & Mohamed (2015) did not provide sufficient information showing the justification of this choice. The practices constituting the capability areas was also not previewed and the way these practices were concluded was not particularly mentioned. Additionally, The fuzzy synthetic method was not clearly explained in the context of this model. Many questions can be raised regarding the weights of each practice assumed in the model and how these weights were assumed. Therefore, this model apparently did follow a particular path for development yet Arowosegbe & Mohamed (2015) was discrete about the details of this path.

Storbjerg *et al.* (2016) also created the ECM maturity grid for Engineering Change Management which includes five main process areas and 26 sub-process areas. ECM was also built to be multidimensional by using the same dimensions mentioned in the CMMI (Storbjerg *et al.*, 2016).

ECM maturity grid was developed to be a multilevel model which evaluates the maturity through five levels throughout 5 main process areas and 26 sub-process areas. The practices composing the maturity grid were extracted from an extensive literature review by Storbjerg *et al.* (2016) and the model as a whole was created and validated through using the comprehensive framework which was developed by De Bruin *et al.* (2005) as shown in Figure 4-8. This framework requires particular phases of developing a maturity model which enables the detailed verification of the applicability of the model (De Bruin *et al.*, 2005). These phases allowed for the rigourous development of the model and testing its validity through case studies as well.

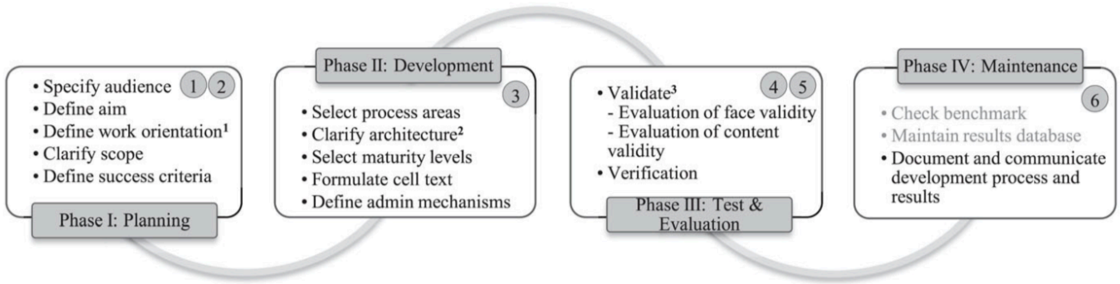

Figure 4-8 The development phases of the ECM maturity grid

Even tough this model was developed by using a highly rigourous process, Storbjerg *et al.* (2016) criticised the model from the perspective that it assumes that all the processes carry the same significance towards the engineering changes which is untrue. Further validation is required towards these practices to understand how much influence each and every practice has over the overall success of the change management process. Additionally, Storbjerg *et al.* (2016) did not clearly specify if this model was created for the construction projects in specific. Therefore, the entire literature review may not have specifically targeted the studies which are related to construction projects in addition to the lack of clarification of wether the validation process of the model involved professionals with construction projects related experience or not. Clearly, further improvement is necessary for this ECM grid to measure the maturity of engineering change management (Storbjerg *et al.*, 2016).

When observing the presented change management CMMs for change management, it could be realised that there are several shortcomings. The first weakness is that even though as per the previous chapters change management takes different shapes when applied in different project phases, these models focus on a specific phase of the process (i.e., planning, executing, etc.) which could contribute to creating a more robust improvement criteria. Second, these models provide a range of details yet are discrete when it comes to the development stages of the models. Even the ECM maturity grid was properly validated on a robust manner, it was fixated on engineering changes only which is limited and does not cover the full extent of project changes. Therefore, it can be considered that there was no explicit explanation for the other models which address project change management as a whole where CM3 and CMCML were not validated on rigorous basis.

Moreover and similar to the majority of the reviewed models, major terminology conflicts could are recognised in the change management CMMs when compared to the CMMI. CMCML used the continuous representation to measure progress in 5 KPA's independently but used the terminology "maturity level" rather than capability levels. This misdirection of terminologies is also present in the CM3 model that targets change management. Sun *et al.* (2009) uses maturity levels to measure a specific area of interest which is change management. Nonetheless, clearly the KPA's are measured independently which makes the growth levels used in the model related to capability rather than maturity according to the CMMI terminologies.

Finally, CMMs do not acknowledge that different change management criteria have varying significance which should be reflected in the model itself to emphasise the importance of specific criterion in the overall improvement of the process. This is a very critical matter that must be taken into consideration when developing a capability maturity model. Otherwise, the results of maturity would deviate from its original purpose of determining the actual capability of the organisation to conduct a specific process.

4.6 CMM DEVELOPMENT FRAMEWORKS

A robust framework for developing the change management capability maturity model should be utilised to ensure that the model is properly established and is built on a rigourous basis. Various studies were involved in illustrating the main phases of developing a successful CMM that is aimed at a specific domain.

CMMs are either developed as conceptual or design-oriented based on empirical testing (Wendler, 2012). Design-oriented models are developed in a specific sequential procedure that would ensure the suitability and reliability of the designed artefact (i.e., the developed CMM) to the contrary of the conceptual models that would not reflect the practical implications of the developed artefact. The biggest benefit of design-oriented models is that the model is constructed through a meticulous way and is validated empirically. This model compliments the body of knowledge through its rigorous development which ensures that the model is fit for its purpose and useful to be used by other researchers (Hevner *et al.*, 2004). To prevent any conflicts in the terminologies, the author shall refer to the processes of developing a CMM as procedure models.

Becker *et al.* (2009) applied the concepts outlined by Hevner *et al.* (2004) to produce a science based CMM procedure model. The procedure model used in the research defines 8 rigorous phases. The phases include problem definition, comparisons of existing maturity models, determination of development strategy, iterative maturity model development, conception of transfer and evaluation, implementation of transfer media, evaluation and finally rejection of the developed CMM.

Becker *et al.* (2009) used a case study to confirm the effectiveness of the proposed procedure model through creating the IT Performance Measurement Maturity Model (ITPM3) accordingly. Becker *et al.* (2009) points out that the procedure model is still in the phase of transfer and evaluation thus future research is needed to establish how effective this model is when applied in the organisation.

Another study performed by De Bruin *et al.* (2005) also developed a procedure model that constitutes 6 phases for developing a design-oriented CMM. These phases are scope, design, populate, test, deploy and maintain. De Bruin *et al.* (2005) clearly provides two case studies in different domains (Business Process Management and Knowledge Management) to prove the effectiveness of the procedure model. De Bruin *et al.* (2005)

used the procedure model in the full development of CMMs. This proves the applicability of that procedure model to the contrary of the procedure model developed by Becker *et al.* (2009) which did not provide a comprehensive CMM that used the development phases proposed by these researchers. Storbjerg *et al.* (2016) developed a maturity grid and validated it through following the stages outlined by De Bruin *et al.* (2005). Table 4-7 compares the phases used in both these procedure models. Essentially, both of these studies provide relatively the same perspective of empirically testing a model rather than simply creating a conceptual model that is empirically tested.

Both procedure models cover homogeneous phases required to develop a CMM. These steps ensure that the model is developed rigourously and is tested for its fitness for purpose. Therefore, the research methodology used in this study will be informed by both these procedure models.

Table 4-7 Comparison of procedure models

	Becker *et al.* (2009)		De Bruin *et al.* (2005)	
	Phase	Objective	Phase	Objective
Phase 1	Problem definition	Determine the scope of the CMM design	Scope	Determine the scope of the CMM design
Phase 2	Comparisons of existing maturity models	Determine the need to develop a new CMM, enhance an existing CMM, combining CMMs, transfer of structure and transfer of content	Design	Define the audience, method of application, driver of application, respondents and application
Phase 3	Determination of development strategy	Based on the CMM comparison, choose CMM development strategy	Populate	Define what elements will be measured and the measurement criteria
Phase 4	Iterative maturity model development	Ensure the CMM is developed step by step	Test	Verifying the validity, reliability and generalisability the structure of the CMM
Phase 5	Conception of transfer and evaluation	Define research methods used in the development of the CMM	Deploy	Ensure generalisability of the model
Phase 6	Implementation of transfer media	Describe explicitly the model components and appraisal methods	Maintain	Ensure growth and maintain the CMM to ensure relevance to the domain
Phase 7	Evaluation	Evaluate the process, effectiveness and quality of the developed CMM		
Phase 8	Rejection of Maturity Model	Negative results may lead to rejecting the developed CMM		

4.7 SUMMARY

This chapter looked into exploring capability maturity models developed for various purposes in the literature which is a very important milestone for this research. CMMs are established as systematic route to improve the organisational processes and achieve business objectives (Paul *et al.*,1991). This concept was developed first for the improvement of capabilities of contractors in the software industries. Later on this concept was transferred to other domains including construction, manufacturing, education, … etc. Next, this chapter focused on the mechanism and operation routes of CMMs. A specific focus was given to the CMMI which is one of the most important and frequently used models according to Wendler (2012).

The structure of CMMI was extensively reviewed and later on appraised against other models found in the literature. The structure included process areas, progressing levels, improvement representation and an extensive view of the very critical appraisal cycle adopted in the SCAMPI methods. Next, CMMI was compared to other CMMs developed for the construction industry in terms of components, objectives and progression criteria. Later on, more emphasis was given to CMMs developed specifically for change management. Clearly, there are several gaps in knowledge when it comes to this particular domain. The gaps identified in the currently established change management related CMMs included various elements related to the model's improvement criteria, improvement representation and finally the model development and validation phases. On this basis, a model is actually required to be properly developed in order to provide the advantage to the contractor by truly measuring the change management capability and improving accordingly. This model needs to be rigourously developed and validated to represent an actually useful tool with elements that are clearly defined and clearly sourced to either the relevant literature or from the industry professionals.

CHAPTER 5 - RESEARCH DESIGN AND METHODOLOGY

5.1 INTRODUCTION

This chapter reviews the general principles of research and research methodologies as a step of understanding the necessity of conducting a research and take decisions in a systematic manner. This chapter will then focus on the selection and justification of particular research methods that was used in this research.

5.2 THE RESEARCH PROCESS

The term “research” is extracted from the term “search” with using the prefix “re” to emphasise the significance of searching (Friedman, 2003). Oxford Dictionary Thesaurus (2001) defines research as the systematic study of resources to explore established facts and attain new conclusions. Similarly, the Australian Qualification Framework Council (2013) defines research as a systematic experimental, theoretical and/or developmental effort that results in contributing to and expanding the established body of knowledge. Research should be oriented towards finding a solution to an organisational predicament, taking advantage of an opportunity or could be stimulated by the researcher’s experience and correlation with science theory (Bryman and Bell, 2011). That would be in addition to filling in knowledge gaps and the routine human demand for growth (Remeny *et al.*, 1998). Even though researches could be different, all studies have the purpose of investigating and the systematically interpreting data (Saunders *et al.*, 2009).

Research is usually undertaken over several stages. A generic guideline was provided by Blaikie (2010) to show that these stages typically follow a pattern of planning, executing and reporting. The sequence of these stages depends on the research conducted itself (Blaikie, 2010). An elaboration of these stages could be identifying the research topic, defining the research problem, deciding on a research route, data collection, data analysis, data interpretation and composing the research itself in the form of a dissertation, thesis or report (Collis and Hussey, 2003). Similarly, Bryman (2015) stated that research stages must include a literature review, concepts and theories ideas, defining a research question, sampling cases, data collection, data analysis and writing up.

A comprehensive research stages model known as the “research onion" was developed by Saunders *et al.* (2012) consisting different stages including research philosophy, approach, method, strategy, time horizon, data collection and data analysis. By using the research onion we acknowledge the importance that our assumptions shape the way in which we view the world. Depending on what research the author chooses to undertake and what assumptions the author have, strategies and methods will differ. This model is known as the research onion and consists a core that is surrounded by five external layers as show in Figure 5-1.

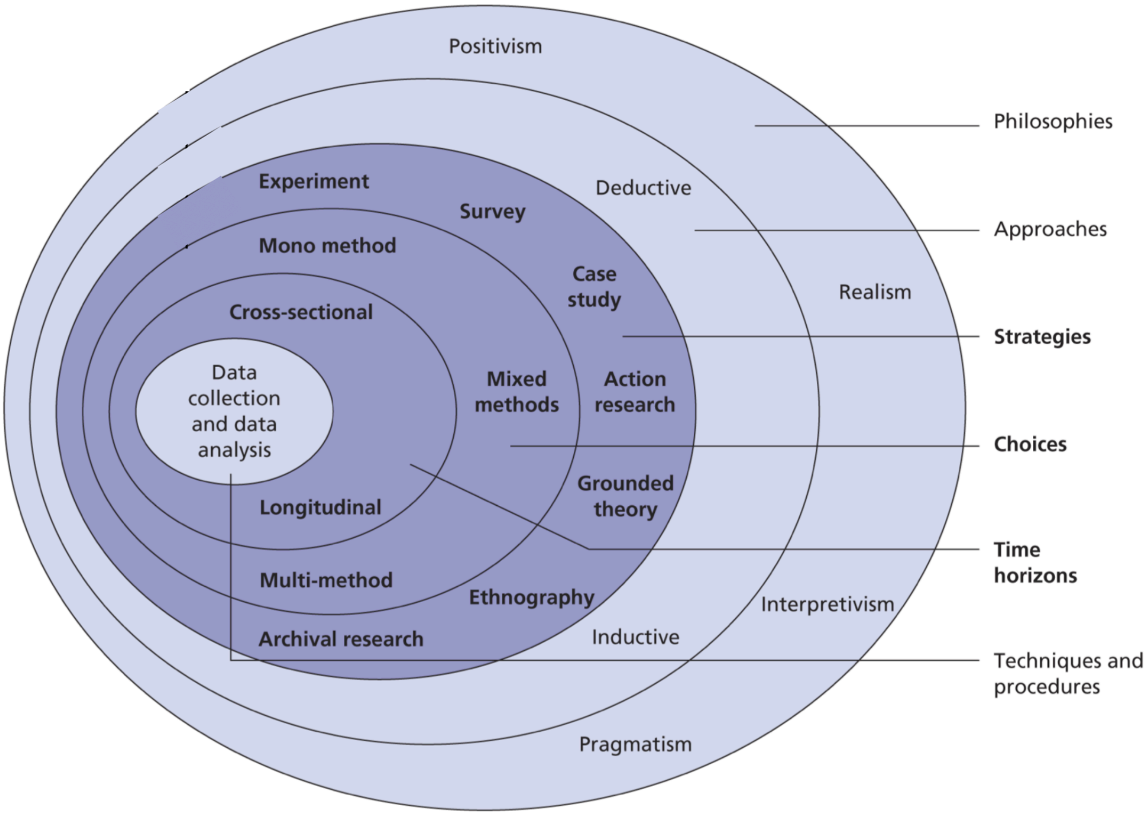

Figure 5-1 Research Onion by Saunders et al. (2012)

This study will follow the model developed by Saunders *et al.* (2012) for various reasons. The model provides an explicit classification of the research process through arranging the stages known as “layers” of research into a sequential order. The author would start with the outer layers of the onion and peel in to the inner layers till reaching the core of the model. Following these layers would guide the author in planning and developing this research. Additionally, following the model developed by Saunders *et al.* (2012) would also acknowledge that the assumptions used influence the strategies and methods used in the study and dictates route to achieving the research objectives.

Therefore, the following section will review the stages presented in the research onion to facilitate the development and planning of this study. The layers of the onion outlines the essential considerations and decisions required by the author prior to the collection and analysis data through showing the sequential path to progress from the outer layers to the core which data collection techniques and data analysis procedures. The layers are described in the following sections according to their sequence and starting from the outer layers to the inner layers.

5.2.1 Research Philosophy

This layer is concerned with the way the researcher perceives the research process. Philosophy is known as the investigation of the cardinal nature of knowledge, reality and existence (Oxford Dictionary Thesaurus, 2001). The research philosophy should be considered at the beginning of any research relevant to the body of knowledge increase. Choosing the research philosophy stage is essential to direct the following stages (Saunders *et al.*, 2012). Easterby-Smith *et al.* (2012) agrees by pointing out the necessity of thoroughly considering the philosophical issues by stressing on the fact that disregarding these issues would influence the quality of work negatively since the research strategy should be extracted accordingly. This emphasis shows how essential it is to properly conduct this essential component of the research. Determining the research philosophy influences the researchers way of thinking. These research philosophies primarily includes ontology, epistemology.

The term “ontology” is made of two greek words “ontos” which refers to being and “logos” which refers to knowledge as pointed out by Gill and Johnson (2010). This combination resulted in different definitions of ontology by various sources in the literature. Ontology is concerned with the nature of reality (Easterby-Smith *et al.*, 2012; Saunders *et al.*, 2012; Fellows and Liu, 2008) or social entities (Bryman, 2012; Bryman and Bell, 2011). It could be recognised that ontology could include two main orientations known as objective and subjective reality (Bryman, 2012; Saunders *et al.*, 2009). Objective reality is independent of its environment while subjective reality depends on who is viewing it (Runeson and Skitmore, 2008).

Gill and Johnson (2010) stated that reality is either real or illusory which carries the same meaning presented by Saunders *et al.* (2009). Objective reality is known as “objectivism” (Bryman, 2012; Saunders *et al.*, 2009) or “realism” (Easterby-Smith *et al.*, 2012; Gill and Johnson, 2010). Similarly, subjective reality is represented by "subjectivism" (Gill and Johnson, 2010; Saunders *et al.*, 2009), "constructionism" (Bryman, 2012) or "relativism" (Easterby-Smith *et al.*, 2012). Even though these terminologies have the same meaning, but the terms featured in the research onion developed by Saunders *et al.* (2009) was be followed. After considering the fact that this terminologies carry the same meaning, focusing on the ontological aspect itself is more important than focusing on the terminology.

The term "epistemology" is made of two greek words "episteme" which refers to science and "logos" which refers to knowledge as pointed out by Johnson and Duberley (2000). Epistemology is known as the theory of knowledge (Bryman, 2012) and what constitutes acceptable knowledge in a particular field of study (Saunders *et al.*, 2012). Another definition of epistemology is provided by Neuman (2011) and is known as the area of philosophy which focuses on the generation of knowledge, how we know what we know and the validity of our ways. Bryman (2012) & Easterby-Smith *et al.* (2012) accordingly points out that epistemological considerations is oriented towards the way, the limits and nature of gathering knowledge.

There are two views to epistemology in the literature. These views are concerned with the objective and subjective knowledge. Objective knowledge is denoted by positivism (Saunders *et al.*, 2012; Bryman, 2012; Easterby-Smith *et al.*, 2012; Neuman, 2011; Gill & Johnson, 2010) while subjective knowledge could be denoted by Interpretivism (Bryman, 2012; Neuman, 2011; Saunders *et al.*, 2009), Subjectivism (Gill & Johnson, 2010) or social constructionism (Easterby-Smith *et al.*, 2012). As above, the terminologies suggested by Saunders *et al.* (2012) will be used in this section. Positivism considers that data is collected based on reality and is independent of any feelings and attitude in collecting the data. While interpretivism focuses on the human behaviour and feelings rather than tangible data. Realism is close to interpretivism and is based on considering what is sensed by us as reality as the truth as shown by Saunders *et al.* (2012).

5.2.2 Research Approach

This layer of the research onion addresses the relationship between theory and research. Researchers always use theory in their research (Saunders *et al.*, 2012). Research is done to either test and validate an existing theory or could be used to come up with a new theory (Bryman and Bell, 2011).

The relationship between theory and research is an important topic that is discussed in various literature sources and should be considered before conducting any research. This relationship is represented by two theories the first being that theory guides research (deductive) and the second is that theory is an outcome of research (inductive) as shown by Remenyi *et al.* (1998), Bryman (2012) & Saunders *et al.* (2009). Research approaches are also viewed as purely empirically or purely theoretical (Remeny *et al.*, 1998).

Saunders *et al.* (2009) points out that deductive theory creates a concise theoretical position prior to the collection of data known as “hypothesis”. Next, this hypothesis is either validated or rejected through conducting the research. The deductive approach is more likely to validate existing theories rather than generating new ones (Bryman, 2012; Remeny *et al.*, 1998). Deductive approaches are more appropriate with quantitative researches which tests the generalisation of already established theories (Bryman, 2012; Saunders *et al.*, 2009). The deductive approach endorses the formation of a hypothesis that relates variables and then this hypothesis is tested by collecting quantitive data to either be confirmed or disproved. The deductive approach also requires a highly structured research methodology that assures the research objectivity, controls variables to facilitate hypothesis appraisal, adequate sample size, quantitatively measurable outputs and generalisation of research conclusions (Bryman and Bell, 2011).

On the other hand, the inductive approach of research points out that data should be initially collected to form findings and generating a hypothesis accordingly Creswell (2009). This approach is used to formulate theory based on data analysis findings (Bryman and Bell, 2011). This approach is more suitable with qualitative research that targets the exploration of a narrow topic rather than generalising a previously established premise. Inductive research utilises a less structured methodology, a small sample size in comparison to the deductive approach. Inductive does not assume the isolation between the researcher and the research itself thus provides a qualitative output that is oriented towards a specific context and place.

5.2.3 Research Methods

This layer is concerned with the type of data collected in the research. Figure 5-2 shows a diagram developed by Saunders *et al.* (2012) to guide the researcher through the different paths of utilising research methods. Clearly, the quantitative and qualitative methods could be used in isolation or collectively in the data collection and analysis. The first is known as "mono method" while the latter is denoted as "multiple method".

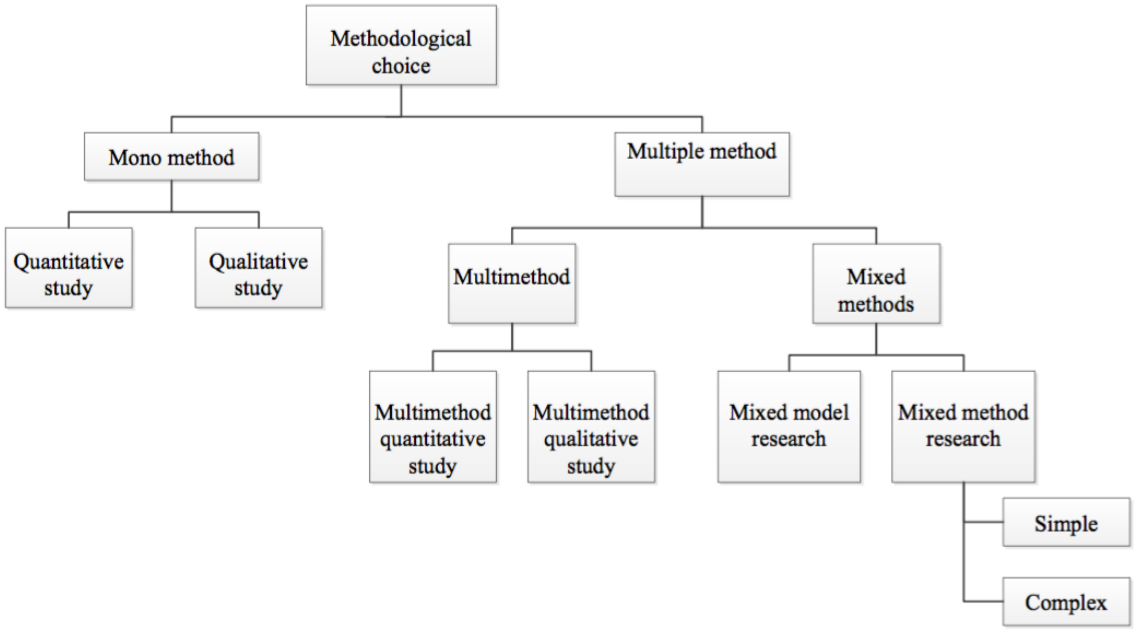

Figure 5-2 Research Methods by Saunders et al. (2012)

The mono method could either facilitate a quantitative or a qualitative route to collecting and analysing research data. The research completely and exclusively follows either path based on which method would answer the research questions more adequately. The mono method allows the researcher to use only one data collection technique in the research followed by data analysis. In other words combining two techniques of data collection within the research is prohibited within the mono methods whether it was quantitative or qualitative.

The multi method on the other hand utilises the attributes of both quantitative and qualitative methods in the research data collection and analysis. Additionally, the multi method allows the use of a group of data collection techniques within the same research to the contrary of the previously mentioned mono method. This option would accordingly offer four possible combinations of mixing quantitative and qualitative methods. These methods are known as multi method quantitative study, multi method qualitative study, mixed model research and mixed method research. Multi methods are formed with multiple qualitative or quantitative methods while mixed methods integrate the usage of quantitative and qualitative methods (Creswell and Plano Clark, 2007).

The multi method quantitive study uses a combination of quantitative techniques for data collection and quantitative data analysis techniques. On the other hand, the multi method qualitative study uses various qualitative techniques at the same time and qualitative data analysis. Both these methods essentially facilitate the usage of various data collection and analysis within the same type of data being either quantitative or qualitative yet does not combine both of these research methods together.

Even though the quantitative and qualitative research strategies are different, various sources in the literature attempted to combine these two methods and apply them simultaneously through a method named “mixed methods” as stated by Saunders *et al.* (2012). Mixed methods include both the mixed method research and the mixed model research. This would contribute to assist the researcher in answering questions that cannot be answered by either the quantitative and qualitative thus mixing these methods are essential (Creswell, 1999). Situations as comparing between tangible evidence and opinions in addition to investigating the possible roots of a quantitive research result would entail the use of the mixed methods.

The mixed method research employs both the quantitative and qualitative methods for data collection and data analysis yet these methods are utilised in an independent manner (Creswell, 1999). The independent application is represented by quantitively analysing the quantitative data while using qualitative techniques and procedures for qualitative data throughout the same research. There is no conversion of data when using the mixed method research.

On the other hand, the other alternative known as the mixed model research which attempts to convert data and work on the compatibility between both quantitative and qualitative methods (Creswell, 1999). For instance, the mixed model research attempts to convert non numerical qualitative data to numerical quantitative data and use quantitative procedures to analyse this data correspondingly.

An essential aspect of the implementation of the mixed methods is about the integration sequence of both methods data collection and analysis techniques (Morse, 1991). The quantitative and qualitative methods could be applied concurrently or sequentially (Azorín & Cameron, 2010). The concurrent procedure entails the collection of data using both the quantitative and qualitative techniques to highlight commonalties and differences between both findings.

On the other hand, the sequential procedure implies that one method of data collection is used first followed by the other based on the research plan. When starting with the qualitative data collection, the purpose of the researcher could be the exploration of a specific matter then target its generalisation on a larger scale or sample (Azorín & Cameron, 2010). To the contrary, using the quantitative data collection first could serve the purpose of verify the variables in a large sample then dig in deep to explore the matter at hand in more depth through the usage of qualitative techniques (Azorín & Cameron, 2010).

Another important factor in the utilisation of the mixed method is the priority of the research method (Tashakkori & Teddlie 1998). The researcher can equally deal with both methods used for data collection or prioritise one over the other depending on several factors (Creswell, 2003). These factors include the nature of the research question itself, data collection restrictions or the necessity of comprehending one type of data prior to proceeding to the next type (Azorín & Cameron, 2010). Table 5-1 compares these various research methods. This comparison highlights the nature, objective, advantages and disadvantages of the quantitative, qualitative and mixed research methods. This table has been informed by various literature sources including Jupp (2006), Walliman (2006), Marczyk *et al.* (2005) and Creswell (2003).

Table 5-1 Research methods comparison

	Quantitative Method	Qualitative Method	Mixed Methods
Nature	• This method focuses on collecting data in a numerical configuration that is measurable and has an objective inclination	• This method focuses on collecting data that is related to social life dimensions that is not quantitively measurable and has a subjective inclination	• The mixed methods focuses on collecting data that considers the subjective and objective aspects to explore a particular matter (quantitative and qualitative data is both collected)
Data Type Examples	• Scientific measurements • Durations • Scores • Event frequency • Ratings • Population counts • Population income • Economic figures	• Attributes • Characteristics • Opinions • Meeting minutes • Observation Notes • Audio/Video Transcripts • Documentaries	• Both quantitative and qualitative data types could be used in this method
Advantages	• Produce facts based on tangible evidence • Objectivity • Testing existing theories • Generalisation of results beyond a specific sample • Most suitable to experimentation types of research	• Investigate a particular situation or event • Explores change in the society • Facilitates the collection of data to a deep extent • Optimum for the micro-level observations	• The combined perspective of both the quantitative and qualitative methods conveys a better picture and a deeper understanding of the matter in hand • One method's output could be employed as the input of the other method. (i.e., interviews results may increase the effectiveness of constructing a questionnaire survey in the research)

Disadvantages	• Prioritise generalisation over depth in a specific environment • Disregards any social or cultural factors influence on the research output • Disregards the social construct of the world	• Researcher subjectivity and bias may influence research output • Research output may not be generalisable and would be environment specific • Not as rigourous as the quantitative research method • Often produces non replicable data • Validity and reliability is often an issue that affects the integrity of the research output	• The research could be a long process (data collection and analysis) which also necessitates heavy funding • Requires that the researcher is highly experienced in the usage of both research methods • The internal validity of the research is questionable by various researchers

5.2.4 Research Strategy

This layer is concerned with the strategies used to answer the research questions and achieve the research aims determined by the researcher. The next stage of research design would be focusing on the choosing of strategies used in the research. The research strategy should be linked to the previous stages as it is essential to follow the guidelines of research to extract sound results. As an instance, the research strategy should be correlated with the research approach and whether it is deductive or inductive in addition to considering the research method required such as mono or multi methods of research.

Selecting which research strategy to use should be based on the nature of the research, the research environment and any other constraint that would influence the ability of this strategy in achieving the research objectives. Combining research strategies was observed by Saunders *et al.* (2012) who concluded that it is feasible to combine various strategies of research to truly achieve the research objective.

Quantitative research strategies could include experiments and surveys while conducting case study, action research, grounded theory, ethnography and archival research is more relevant to the qualitative method. Nonetheless, it is worth noting that some strategies could be used by either methods. For instance, surveys could be either quantitively or qualitatively based depending on the aim of the research and how the survey is used. The research strategies used in this study is be reviewed in the latter sections.

Table 5-2 illustrates the scope of different research strategies under the quantitative and qualitative methods. This comparison adopted from by Jupp (2006) and Walliman (2006).

Table 5-2 Research strategies comparison

	Scope of the Research Strategy
Experiments	Focuses on altering one variable (independent variable) and observing the effect of this change on another variable (dependent variable)
Surveys	Focuses on producing a structured data grid that is variable by each participant
Case study	Focuses on in-depth investigations of a particular case through extracting data from various sources
Action research	Focuses on the research partnership between the researcher and participants to find the influence of a particular intervention results (there is a form of collaboration)
Evaluation research	Focuses on observing the influence of a particular intervention results without the involvement of the researcher (there is no form of collaboration)
Grounded theory	Focuses on the formation of a theory based on the data collected throughout the study
Ethnography	Focuses on social attributes, characteristics and cultural aspects of a particular setting or a social group
Archival research	Focuses on the historical orientation of a particular case study based on exiting or historical data over a certain time span based on the research objectives

5.2.5 Research Time Horizons

Time horizons shows if research to either be a snapshot or over a specified period. The time horizon layer of the onion also considers the time horizon considered in the study. There are two time horizons which are namely cross–sectional and longitudinal that can be used in the research (Saunders *et al.*, 2012). Cross-sectional is generally considering a short term research data collection while the longitudinal horizon assumes that the research will be undertaken over prolonged periods of time. The choice of which horizon is more suitable for the research should be contemplated in alignment with the research questions itself.

Cross sectional researches observe and compare between various instances occurring within a single moment and presumes the collection of data at that specific timing of the horizon (Bryman & Bell, 2011). This research design could also observe an individual or group attributes within a specific point of instant. Cross sectional researches could be done as a one-off or repeated at regular intervals (Jupp, 2006). Lavrakas (2008) mentions that cross sectional researches disregards time and does not consider it one of the variables throughout the process. Lavrakas (2008) added that this does not necessarily mean that all the data is collected at the exact instance, yet it is collected within a very short timeframe to the contrary of the longitudinal research design that extracts data over a longer period of time.

Longitudinal researches on the other hand observes a phenomenon and how it is influenced over a predefined and long period of time (Jupp, 2006). This research design observes quantitative and qualitative samples over a long period of time in comparison with the cross sectional design. This could be perceived as an escalating resource consuming process which could represent a challenge to proceed in conducting the research itself in cases of limited funding. Due to time and cost constraints, the usage of the longitudinal horizon is limited in the field of management as pointed out by Bryman & Bell (2011).

5.2.6 Research Data Collection and Analysis

The core research data collection and analysis techniques and procedures used in the project. This is the part of research where a researcher should consider the most suitable routes to sampling and data collection. This stage should be built on the basis of the previously reviewed stages as shown in the research onion developed by Saunders *et al.* (2012) to assure the quality of the output which will be discussed in the upcoming section of this chapter.

Easterby *et al.* (2008) defined a sample as a selection of groups or subsets within the population. The population is the total of all groups that is compliant to a specific set of criteria (Blaikie, 2010). The sample should be representative of the population (Blaikie, 2010) since data cannot be extracted from every group of the population due to the research's time and financial limitations (Ticehurst & Veal, 2011; Lavrakas, 2008). From this need, arises the term "sampling" which is one of the most essential factors in the research design stage (Jupp, 2006). Sampling is the techniques used to choose the representative groups from the population (Jupp, 2006).

It is also important to acknowledge other terms prior to conducting the sampling process. For instance a parameter refers to an actual measure that covers all the population while a statistic is an estimate based on a sufficient sample drawn from this population by the usage of sampling techniques (Jupp, 2006). The statistic is an assumption hence is not necessarily identical to the parameter. Therefore, the researcher needs to use statistical significance tools (for example Chi-Square) to ensure the degree of the sample's representation of the total population (Walliman, 2006). This process is known as the inferencing process and is used to either confirm or deny the generalisation possibility of the sample results to the population (Levy & Lemeshow, 2013).

It is crucial to assure the effectiveness of the sampling techniques used in research. These aspects vary depending on the research method thus correlated with the research either being quantitative or qualitative as it will be discussed next.

When considering the quantitative approach, it is important to focus on a fully representative sample that would allow the researcher to generalise the research findings. Additionally, the researcher should be concerned with the sample size adequacy as bigger sample sizes tend provide the researcher with more accurate results (Jupp, 2006). Saunders *et al.* (2012) add that using a sufficient sample size to assure the quality of the output. Ticehurst and Veal (2011) claims that a sample size should be set in alignment with the requirements of results accuracy, analysis detail requirements and financial limitations.

Sampling techniques are broadly classified into probability and non-probability techniques. The probability techniques ensure that all the elements in the population has the potential to be chosen (non zero probability) while the non-probability techniques lacks this prospect in selecting the population elements (Oppenheim, 2000). Additionally, probability sampling provides the researcher with an idea of how close the sample statistics concluded to the population's actual parameters unlike the non-probability sampling techniques (Oppenheim, 2000). Therefore, using probability sampling techniques provides a more reliable and representative sample. The following techniques are categorised under either one of these classifications of sampling.

Opportunity sampling is one of the techniques that employs the knowledge and experience of the researcher in identifying the sample of the population which will be used to proceed in the research. Nonetheless, this method of sampling is consider the weakest method in choosing the sample since it is the least demanding method of sampling when it comes to resources and expertise as pointed out by Jupp (2006).

Snowball sampling (otherwise known as chain letter sampling) is another sampling technique featured in the literature. In snowball sampling, the researcher would recognise a suitable participant which is later on requested to identify another respondent for the research. This process is repeated up to a point of acquiring a sufficient amount of data for the research based on participators' nominations (Biernacki *et al.*, 1981).

The homogenous sampling is used to extract information from participants with parallel backgrounds, knowledge and experiences. The advantage of this method is that it limits the variations and simplification of analysis (Patton, 2005).

The purposive sampling (otherwise known as judgemental, theoretical or criterion sampling) is utilised to select cases based on a predefined criteria of the researcher (Walliman, 2006) and is ideally used in the case study method. The purposive sampling non-probability tool (Jupp, 2006) will allow to refine the cases considered in this study and will assure the quality of the cases examined and optimise the research findings accordingly (Quinlan, 2011).

Other sampling techniques include the random, systematic and stratified sampling (Collis & Hussey, 2003). The random sample entails that all the samples have an equal chance to be selected (Jupp, 2006).

Stratified sampling on the other hand is used to enable the research to select the equal size of random samples from different categories (Bloor & Wood, 2006). The simple stratified sampling draws equal samples from the different strata to the opposite of the proportional stratified sampling that takes into consideration the population of the strata and combines the drawn samples from each stratum accordingly. The proportional stratified sampling is more suitable when each stratum's populations is known and would provide the researcher with better insight to the overall population characteristics (Walliman, 2006).

The systematic sampling on the other hand entails that the researcher sets a constant sampling frequency (known as sampling interval) to select a sample in a large population (Walliman, 2006).

Sampling should also be satisfactory to the requirements of the qualitative research which is less demanding in comparison with the quantitative approach. Thus preserving the authenticity of the sample would suffice for sampling within the qualitative approach since the purpose is to investigate and explore the matter at hand on a deeper level. This requires that the sampling properly conveys the information delivered extracted from the qualitative methods utilised in the research. Which tilted the thinking of researchers to state that the significance of sample size in the qualitative research is not as crucial as it is in the quantitative approach since satisfying the research objective and answering the research questions to a deep extent is the main target of qualitative research (Silverman, 2011; Creswell, 2003).

Jupp (2006) & Walliman (2006) claims that the bigger the sample is the more representative it is to the population. Dixon (1987) adds that the most basic research needs a sample size of 30 responses in order to enable data analysis. Nonetheless, some populations are relatively small therefore a small sample would suffice (Ruqaishi & Bashir, 2015).

The determination of the sample size is primarily influenced by the level of precision (Oppenheim, 2000), confidence level and variability (Israel,1992). Precision (otherwise known as sampling error) refers to the range in which the true population number is approximated to be. Confidence level focuses on the percentage of samples representation to the population. For instance a confidence level of 90% means that 90 out of a 100 sample possess the true the value of the population. Variability indicates the homogeneity of the population where a non-homogenous population would require a bigger sample size than the homogenous one.

After taking these factors into consideration, a range of strategies could be used to figure out the sample size. These strategies are utilising a census for small populations, imitating a sample size of similar studies, utilising published tables and applying formulas to calculate a sample size (Israel,1992). Utilising a census for small populations means that all the population will be sampled which would eliminate any issues in sample repression but may be daunted with time and cost constraints. The next strategy requires reviewing similar studies and choosing an adequate sample size accordingly even though risking also the duplication of an error if the sample size was sufficient in the similar study (Israel,1992). Additionally, the researcher can use tables that is formulated based on precision, confidence levels, and variability to determine the required sample size or in this context, the number of responses. Finally, formulae can be used to determine the sample size. Kish (1995) developed a formula to determine the sample size for a small population, while Cochran (1963) and Yamane (1967) used another formula to determine the sample size for bigger populations.

The previous formulae depend majorly on the precision, confidence levels, and variability to determine the sample size (Israel,1992). Nevertheless, the sample size required is also positively associated with the increased number of variables required for analysis and the type of analysis where using statistical techniques would typically require a bigger sample size (Walliman, 2006).

When wondering the matter of the sample size, it is important to expect a realistic sample size according the prevailing constraints (Oppenheim, 2000). This perspective is aided by Olejnik (1984) who stated that the researcher should simply select the biggest possible sample size within the constraints time, cost and effort.

The data can be collected from the sample through a range of methods in the research. Walliman (2006) also stated that data can be collected through self-completion questionnaire, interviews (structured, semi-structured and unstructured), detached and participant observation and finally the personal accounts and diaries. Observation, interview, documents in addition to audio and visual materials were specifically deemed most suitable data collection method for the qualitative research as shown by Creswell (2003) while questionnaires were recognised as most suitable for quantitative methods (Walliman, 2006).

5.3 DATA COLLECTION METHODS

The data from the sample is collected through data collection methods such as questionnaire surveys, interviews and case studies. These data collection methods will be deeply explored in the sections.

5.3.1 Questionnaire survey

The questionnaire survey is a commonly used data collection method that includes a group of questions that is distributed to the research participants. It is essential to properly design the questionnaire to draw reliable and generalisable conclusions in the research (Oppenheim, 2000). The weakly designed survey will provide the researcher with insufficient findings and conclusions, limit the generalisation of the findings and therefore will be resource wasteful (Jupp, 2006). Questionnaire surveys could be designed as either descriptive or analytic based on the objective of the research. The questionnaires necessitating the understanding of a frequency of a particular event or finding facts are considered descriptive while the questionnaires focusing on the investigation of the causes triggered a particular event are considered analytic questionnaires. Therefore, descriptive questionnaires are ideal to answer questions starting with “how many” while analytic questionnaires are best used to answer questions starting with “why” according to Oppenheim (2000).

Various considerations should be given prior to drafting the questionnaire survey. These considerations include the data collection instrument, method of approach to respondents, the construction of the questions and their sequence and finally the types of questions to be used (Oppenheim, 2000).

The data collection instruments may include mail, self administered and group administered questionnaires. The approach to respondents is important to enhance the cooperation and increase the response rate of the questionnaire. Approaching the respondents should include an advanced notification, explanation of selection, sponsorship, envelope, publicity, incentives, confidentiality, reminders, appearance, length and rapport (Oppenheim, 2000).

The questionnaire consists of different modules addressing different variables but typically starting with personal data questions such as years of experience, current position, … etc. The sequence of these modules needs to follow a particular pattern such as the funnel approach which allocates broad questions at the beginning and more specific questions at the end of the questionnaire (Oppenheim, 2000).

Finally, the nature of questions used in the questionnaire needs to be determined. The choice of which nature of question is dependent on the requirement of the particular questionnaire or the questionnaire module in specific. The nature of questions includes open-ended questions, close-ended questions and Likert scales (Marczyk *et al.*, 2005) as shown and contrasted in table 5-3. Open-ended questions allow the respondent to answer freely without limiting the answer to a particular option. To the contrary, close-ended questions offer particular options and is in the form of either a dichotomous (yes or no questions) and multiple choice questions. The Likert scale on the other hand offers a range of declarations for the respondent to choose in an evaluative way (Vogt, 1999). Likert scales could indicate the respondents perspective of agreement, relevance, value, frequency, significance, quality and possibility through either a dichotomous scale (2 points scale), 3 points scale, 4 points scale, 5 points scale or 7 points (Brown, 2011) as an overall attempt to quantify the respondents qualitative opinion. Other scales such as the Analytic Hierarchy Process (AHP) scale could be used to select from a pair of alternatives according to the degree of preference.

Using the questionnaire data collection method in a research is frequently coupled with the response rate predicament (Jupp, 2006). Questionnaires are close ended questions which may push the researcher to use an additional data collection method to further investigate a particular topic. For instance, an additional interview may be necessary to complement the exploring nature of the study and achieve the research objectives. Moreover, bias may influence the response of the participants since the questions could be interpreted in a different way from the researchers intention (Walliman, 2006).

Table 5-3 advantages and disadvantages of open and close ended questions

	Open ended questions	**Close ended questions**	**Likert scales**
Advantages	• Unlimited possibilities of answers • Detailed answers and justifications could be provided • Sufficient answers for complex questions • Enhances creativeness in the answer • Revealing the logic of the respondent	• Time efficient • Comparable answers by different respondents • Statistical analysis and processing is easy • Less risk of incorrect answers • Replication could be facilitated easier	• Time efficient • Comparable answers by different respondents • Easy to comprehend • Allows respondent to choose from a spectrum of choices • Ideal to indicate the extent of the respondent's agreement rather than a firm yes or no answer • Neutral answers are facilitated • The response is quantifiable
Disadvantages	• Time consuming • The coding process of data requires a lot of effort • Risk of irrelevant answers • Comparing answers may be challenging • Statistical analysis may be challenging	• Respondents with no knowledge of the topic may answer anyway • The answers are limited to the offered choices only • Not suitable to answer complex issues by simplistic choices	• True attitudes of the respondents are not necessarily reflected through the response • Extremes are often avoided by respondents • Interval between two answers could be perceived differently by different participants

5.3.2 Interview

Another favoured choice for data collection is the interview. Interviews are extremely effective in achieving the objective of this study as this technique carry numerous advantages that separates it from the remaining qualitative data collection techniques. Interviews facilitate the exploration more than questionnaire surveys that are suitable for one-stage questions that do not allow the in-depth investigation of the matter in hand (Walliman, 2006). Interviews also allow the interviewer to detect the responses, motives and feelings of the interview. This can in return enhance the value of the qualitative dimension of the data collected (Jupp, 2006). This interaction between the interviewer and interviewee assures the alignment between the interview output and the research objectives (Saunders *et al.*, 2012). Moreover, in-depth exploration of the research topic is featured through interviews. Miscommunication can be avoided through interviews since the interviewer can clarify and elaborate on the questions and prevent any unintended answers thus improve the reliability of data collection process output (Quinlan, 2011). An important aspect of the interviews is whether technology will be used to conduct the interviews or a face to face interview would suffice. Different technologies and softwares such as Skype or FaceTime could be used to communicate with interviewees abroad (Bryman and Bell, 2011).

Another aspect is the number of participants per interview. Interviews could be conducted on a one on one basis or as a group focus technique that includes a group of interviewees. Focus groups could be faster and more cost effective than individual interviews in addition to securing the same number of responses (Bloor & Wood, 2006). Additionally, the group discussion may trigger a very beneficial discussion between the interviewees thus exploring areas that would have not been explored in an individual based interview (Bloor & Wood, 2006). On the other hand, the organisation of the session outputs requires group dynamics management by the interviewer. These skills are also needed to prevent particular incidents that may affect the quality of the focus group output.

The interviewer should assure the avoidance of criticism between the participators in the discussion and preserve a friendly environment where the focus group would be at an optimum state of information sharing and being able to freely discuss particularly debatable topics (Marczyk *et al.*, 2005). Another huge disadvantage of the focus group is that participants need to free their schedules and meet up in one timing that may not fit all their tight schedules constraints thus cause delays in scheduling the focus group timing. This clearly shows how focus groups when conducted with professionals of high positions within the construction industry could be perceived as impractical.

The next aspect to consider in the interview is whether the interview is semistructured or unstructured (Marczyk *et al.*, 2005). The semistructured interviews includes a formal list of questions that could be sued to lead the discussion with the interviewee. These questions are not set to limit the discussion in the interview yet should be used as a starting point to explore the research topic. On the other hand unstructured interviews would facilitate an open discussion about the research topic without the usage of key questions. The interviewee would be encouraged to express their knowledge, opinion and feelings about a particular manner through an informal dialogue with the interviewer. It is obvious that the semistructured interview would improve the focus on specific points where the interviewee would express their opinions in a more systematic way. Answering each question would increase the ability of the author to eventually preserve the interview scope without skewing to irrelevant arguments within the interview.

Nevertheless, interviews carries few downsides as shown in the literature. Setting up interviews is time consuming and prone to the schedule constraints of the interviewee. Additionally, there is a risk of ilnyuencing the data collection output since the researcher would be involved in the data collection process and can sway the responses of the interviewee in any direction. In other words this technique could be exposed to subjective bias which would have an impact on the reliability of the results (Quinlan, 2011). Walliman (2006) also emphasised that it could be a common pitfall to improperly interpret the meaning of the interviewees answers thus imposing the author's view in the result. Nonetheless, this disadvantage could be avoided through keeping this factor in mind when conducting the interview and request elaboration on the interviewee's answer when vagueness is encountered.

5.3.3 Case study

The case study approach deeply investigates a sample or more through collecting data by different sources (Jupp, 2006) and is suitable for both quantitative and qualitative types of research. Cases studies allow the researcher to have a closer look into particular issues within a particular context (Zainal, 2007). The utilisation of case studies is considered a vigorous research method when applied holistically and through the integration of deep investigation (Zainal, 2007). The depth provided by case studies is ideal to convey the full picture of the social behaviour to the contrary of other quantitive methods which may lack the feature of delivering deep explanations (Zainal, 2007).

Case studies are mainly categorised into being descriptive, exploratory or explanatory (Yin, 1984). Descriptive case studies focus on providing comprehensive view of the phenomenon being studied and providing the reader with full description accordingly (Zainal, 2007). Exploratory case studies aims at an initial inspection of a phenomenon that will be later on intently explored. A pilot study is considered a typical example of an exploratory case study (McDonough & McDonough, 1997).

Initial data could be extracted to draw the framework and primary questions of the exploratory case studies (Yin, 1984). Explanatory case studies on the other hand focuses on explaining the triggers causing a particular phenomenon and the causal relationship between variables in the sample or samples studied (Zainal, 2007). It is also worth mentioning that McDonough & McDonough (1997) explained that there are other types of case studies known as interpretive and evaluative case studies where interpretive case studies focus on interpreting the data through creating conceptual groupings that brace or dispute the assumptions made concerning this data while the evaluative case studies focus on appraising the phenomenons and patterns recognised in the data.

Several disadvantages were raised about the case study method. Various sources point out that case studies do not necessarily provide generalisable findings since it has a high focus on particular cases only (Zainal, 2007; McDonough & McDonough, 1997; Yin, 1984). This type of design would provide more precise findings that may or may not be applicable to any other cases (Zainal, 2007). Yin (1984) also realised that case studies could lack rigourous evidence of proper operation.

Additionally, case studies require a lot of documentation and should be managed systemically or the integrity of the findings may be jeopardized (Yin, 1984). Since the case study approach is perceived to be lacking robustness if not properly designed (Zainal, 2007), the method of case study could either be designed as a single-case or multiple case. A single case study is suitable to the instances where the phenomenon is sole and not replicable. The multiple case design focuses on various cases rather one due to the availability of different sources through the utilisation of replication (McDonough & McDonough, 1997). Since investigation is at the core of the cases study method, the generalisation of findings is not one of the aims of this methods (Walliman, 2006). Nevertheless, generalisation could be achieved through case studies if the studied sample or samples are considered well representative as pointed out by (Campbell, 1975).

5.4 DATA ANALYSIS

After collecting data in the research, the focus should be on analysing this data as a step of drawing conclusions and answering the research questions based on the collected raw data (Walliman, 2006). Analysing this data could be undertaken through different analysis techniques and procedures. A distinction should be made between analysing quantitative and qualitative data since the characteristics of these two types are dissimilar thus the analysis should be done differently. Table 5-4 compares between the nature of the quantitative and qualitative data analysis.

Table 5-4 Quantitative and qualitative data analysis comparison

	Quantitative Analysis	**Qualitative Analysis**
Sampling size	Large and well-representative	Small and defined
Scope	Examining variables	Identifying themes Discover patterns Interpretation of language usage
Raw data	Numbers	Words
Nature	Statistical nature involves conducting mathematical operations	Non-statistical nature involves the researcher's observation
Timing	After data collection	Parallel to data collection (after obtaining some data)
Reliability	Based on the measurement consistency and replication	Based on the data making sense

5.4.1 Quantitative data analysis

Quantitative data analysis techniques vary through a wide range of options that utilise mathematical operations to investigate the meaning of raw data. The techniques of quantitive data analysis depends majorly on the level of variables measurement in the data collection method such as nominal, ordinal, interval or ratios (Jupp, 2006; Walliman, 2006). Nominal variables are the ones that cannot be ranked, ordinal variables can be ranked with unclear ranges, interval variables can be ranked with clear ranges and finally the ratio variables are measured in relevance to a particular value.

Table 5-5 compares between the properties of the nominal, ordinal, interval and ratio variables to highlight the difference between these dissimilar levels of measurements based on different sources including Jupp (2006) & Walkman (2006). Nominal variables can include gender, occupations, affiliations, eye colours, hair colours, … etc. Ordinal variables can include education levels which require a different number of years for completion. Interval values can include the temperatures where the intervals carry the same meaning when comparing different temperatures. Ratio on the other hand can be used for variables which have the same zero or starting point such as height or weight. Temperature represented by Celsius and Fahrenheit are not considered ratio variables as the zero in both systems does not truly have the same value.

Table 5-5 Measurement levels properties

	Nominal	Ordinal	Interval	Ratio
The values could be arranged in sequence	-	√	√	√
Frequency distribution	√	√	√	√
Mode	√	√	√	√
Median	-	√	√	√
Mean	-	-	√	√
Quantifiable range between the values	-	-	√	√
Addition & Subtraction	-	-	√	√
Multiplication & Division	-	-	-	√
Contains an actual zero (where the variable is truly equal to nothing)	-	-	-	√

It is clearly indicated how some properties differ between different levels of measurement and how some statistical calculations may apply to one level and not apply to the other. Most importantly, nominal and ordinal variables are considered to be non-metric variables while the interval and ratio variables are metric (Jupp, 2006).

Quantitative data analysis techniques are accordingly classified into two types which are parametric statistics and non-parametric statistics techniques (Walliman, 2006). Parametric techniques rely on data that complies with a specific parameter and is considered metric to the contrary of the non-parametric techniques that would provide less sensitive analysis and used to recognise characteristics amongst non-curve data (non-metric). Parametric tests include the univariate, bivariate and multivariate analysis types. The univariate focuses on the properties of one variable while the bivariate focuses on the correlation of two variables and the multivariate focuses on more variables correlation. Table 5-6 provides an overview of the frequently used statistical tests and their categorisation to either univariate, bivariate, multivariate or non-parametric as pointed out by Walliman (2006).

Table 5-6 Statistical tests by Walliman (2006)

Univariate analysis	Frequency distribution Measure of central tendency Measures of dispersion
Bivariate analysis	Pearson's correlation coefficient Spearman's rho Kendall's Tau Phi Cramer's V Eta Chi-square One-group t-test Two-group t-test Anova
Multivariate analysis	Multiple regression Logistic regression Path analysis Factor analysis Multi-dimensional scaling Cluster analysis Structural equation modelling Analysis of variance
Non-Parametric	Komogarov–Smirnov Kruskal–Wallis test Friedman test Cramer coefficient Content analysis

5.4.2 Qualitative data analysis

When it comes to qualitative data analysis, the researcher can conduct the data analysis in parallel to the data collection after obtaining some data to the contrary of the quantitative analysis which requires the completion of the entire process of data collection prior to starting the analysis. Jupp (2006) mentions that qualitative analysis focuses on the themes, interpretation and use of language to assure optimum and meaningful output.

Since qualitative data represented by words, pictures or sound cannot be mathematically analysed, certain steps were presented to analyse this type of data by Walliman (2006) & Creswell (2003). These steps essentially depend on the organisation of data for analysis, familiarisation and examining the context of this data, using the coding process, exploring and/or developing themes, discussing the themes recognised and finally the interpretation of the results.

The researcher should interpret the results based on sound reasoning since this is the basis to convince the reader of the research output and to answer the research questions (Walliman, 2006). Therefore, the upcoming sections will focus on the coding process and identifying themes in qualitative research.

Coding is concerned with the arrangement of data to fit within a classification or a particular categorisation (Saldaña, 2015). This data is isolated, organised, reorganised, compared and connected to convey a specific meaning in the research (Grbich, 2007) or the emergence of a pattern that could be useful in the expanding the study's insight boundary.

The codes are put under categories and themes. Categories are either words or phrases that explicitly elaborates on the meaning of the codes while themes are less obvious and focuses on the implicit meaning of the codes (Rallis & Rossman, 2003).

Saldaña (2015) emphasised the significance of using analytic memos to reflect on the manner through which the coding process is conducted by the researcher. This memo serves various purposes including the methods of coding and the justification of choices made by the researcher. This reflection allows the author to step back and critically think of the methods and processes used (Clarke, 2005) in order to facilitate improvement and increase the ability of learning specially for novice coders (Saldaña, 2015). The author will keep an analytic memo to constantly reflect about the coding process and try to interact with the process outputs. More importantly, the memo may also aid the author in figuring out different classifications and coding techniques that would be mostly suitable to this study through expanding huge researcher's experience in coding. Finding the most suitable coding technique is essential since there is no specific technique is perfectly suitable with the qualitative research, it rather depends on the researchers experience in coding (Saldaña, 2015).

The process of coding is undertaken over several cycles (Saldaña, 2015). This repetition of coding brings an enhanced insight to the researcher and allow further recognition of any emerging patterns within the data. Abbott (2004) emphasises the importance of this repetition process through pointing out its similarity with decorating a room that is done within various cycles of decorating, stepping back, redecorating and so on up to the point where the room's decoration seems satisfactory to the user.

Different techniques could be used in coding (Saldaña, 2015). The techniques used in the first iteration is known as the first cycle methods while the ones used next are known as second cycle methods. This is similarly extended to cover the third cycle methods, fourth cycle methods, … etc. Saldaña (2015) present figure 5-3 to show the different types of first and second cycle methods of coding.

The literature provides a wide array of coding method(s) that are suitable for first and second cycle coding. Patton (2002) mentions that the selection of a coding method is not straight forward since the nature of each study is different. Flick (2002) suggested various criteria to determine the suitability of coding method(s) selected with the nature of the study. The criteria include harmony of the study's framework with the coding method, the research method should assist in answering the research questions not create vagueness, comfort in applying the coding method and smoothness of the coding process, suitability of the codes to the type of data (transcripts, field notes, figure, … etc.), generating adequate number of codes to later on analyse the data, the method should lead the researcher to a pathway of categories, themes and eventually a theory, generation of connections and finally, the coding method should allow the discovery of patterns between the data collected.

The criteria mentioned focuses on relating the coding method suitability with the progress of the researcher is closing in on answering the research questions and achieving progress in the coding process. It still does not provide a solid basis to select a suitable coding method from the first iteration. This criteria rather guide the author in determining if the coding progress is deemed satisfactory or switching to another method is necessary.

To the contrary, Saldaña (2015) recommended specific first and second cycle methods to be used in the coding process. These methods are generic and are frequently suitable to qualitative studies. Saldaña (2015) emphasised the usage of attribute coding, structural coding, descriptive Coding, *InVivo* coding as first cycle methods.

FIRST CYCLE CODING METHODS

Grammatical Methods
- Attribute Coding
- Magnitude Coding
- Simultaneous Coding

Elemental Methods
- Structural Coding
- Descriptive Coding
- In Vivo Coding
- Process Coding
- Initial Coding

Affective Methods
- Emotion Coding
- Values Coding
- Versus Coding
- Evaluation Coding

Literary and Language Methods
- Dramaturgical Coding
- Motif Coding
- Narrative Coding
- Verbal Exchange Coding

Exploratory Methods
- Holistic Coding
- Provisional Coding
- Hypothesis Coding

Procedural Methods
- OCM (Outline of Cultural Materials) Coding
- Protocol Coding
- Domain and Taxonomic Coding

Themeing the Data

SECOND CYCLE CODING METHODS
- Pattern Coding
- Focused Coding
- Axial Coding
- Theoretical Coding
- Elaborative Coding
- Longitudinal Coding

Figure 5-3 First and second cycle methods of coding

5.6 THE RESEARCH METHODOLOGY USED IN THIS STUDY

This research aims to investigate the change management process for contractors and develop a capability maturity model that evaluates the capacity of the contractor to adequately manage project change. Figure 5-4 previews research flow and the outcomes of different stages. The following section shall describe and justify the research methodology choices used in this study.

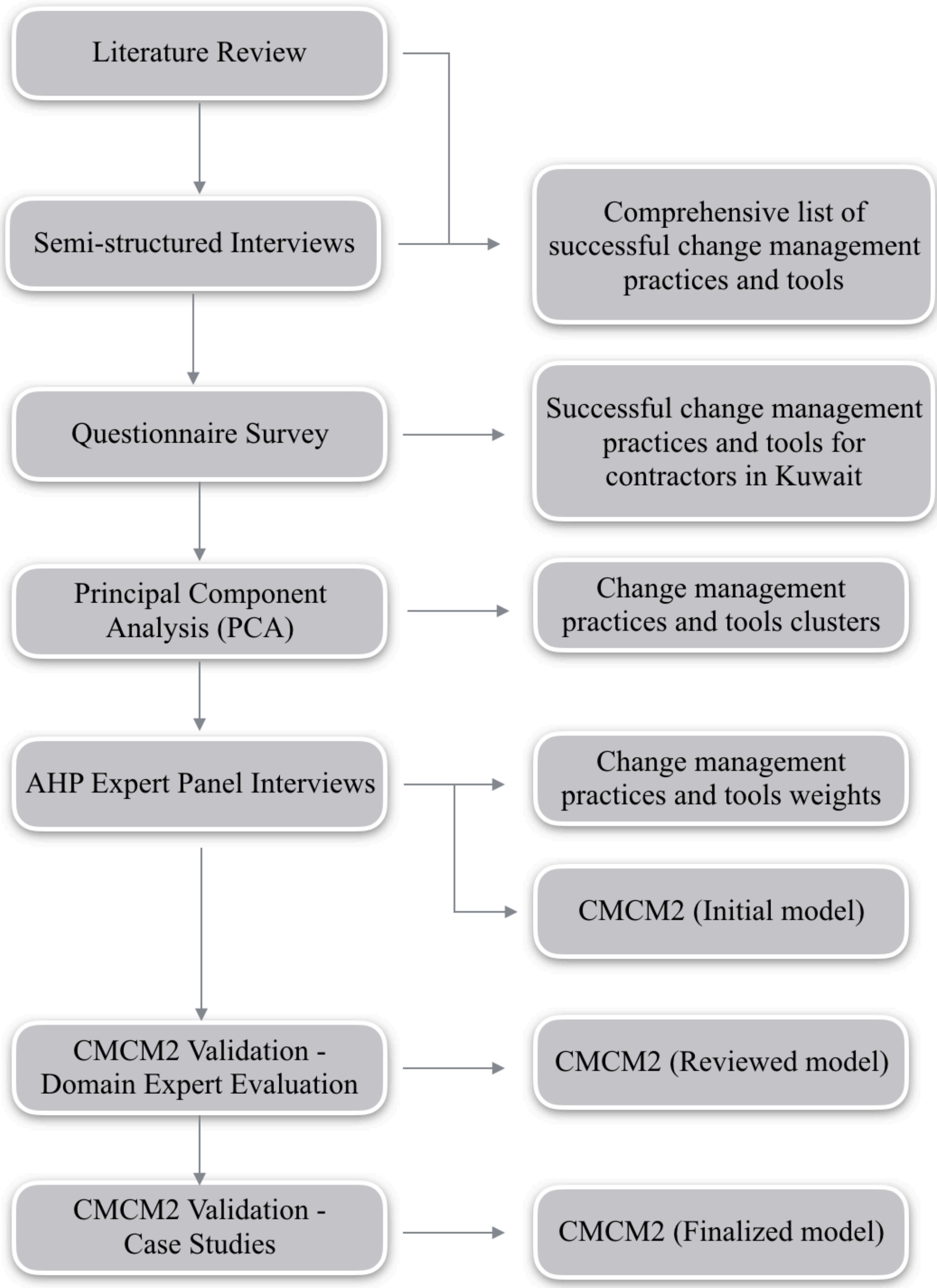

Figure 5-4 The research process flow

5.6.1 *Research philosophy and approach*

The decision made on the basis of the previous review is that this study employs the inductive theory, constructivism and interpretivism. The basis of this choice is that constructivism takes account for the social events triggered by social actors' dynamic conduct, while interpretivism emphasises the human behaviour and feelings rather than solid evidence. These research philosophies are represented by the examination of change management processes and procedures based on the experiences and perspectives of contractors in the Kuwaiti construction industry. The research output is thus correlated with the deeds of the contractors and is corresponding to their behaviour and feelings rather than solid evidence.

This research used the inductive research approach which generates a theory based on research findings. This approach is suitable for this study since data collection and analysis techniques and procedures are the basis of examining change management practices and procedures of the contractors to create a capability maturity model that corresponds to the most suitable practices. Since theory is limited in the field of change management capability maturity models, the inductive approach is preferable (Saunders *et al.*, 2012) as it creates conclusions from the research observations rather than relying on currently established theory.

Essentially, the time horizon needs to be defined in this study. This study intends to collect data through a specific and relatively short period of time. Due to this research's nature, the cross sectional horizon would be more suitable to achieve the research objectives.

5.6.2 *Methodological choice*

After selecting the research philosophy and approach, the next step is to focus on choices for research methodologies and strategies for specific methods. The sequential mixed methods were used in this study. The mixed methods concentrates on collecting qualitative data first followed by collecting quantitative data to achieve the research objectives. The combination of both the qualitative and quantitative research aspects allows the investigation of successful change management practices and procedures by the contractors in Kuwait and to generate the essential success criteria for managing project change. Subsequently, a design-oriented CMM was created based on the optimum practices used by contractors in Kuwait and validated through a diligent process for verification of application and fitness for purpose.

5.6.3 Sampling

The design process of a questionnaire starts with drawing a representative sample from the bigger targeted population. To draw the sample, a suitable sampling frame is required. Researches conducted in Kuwait usually use the list provided by Kuwait's Central Tenders Committee (CTC) as a sampling frame. For instance, Jarkas & Bitar (2012) used the list provided by CTC as a sampling frame to determine the leading factors which were causing deterioration in labour productivity in contracting companies in Kuwait. Therefore, the sampling frame used in this study is the one provided by the CTC website which shows a comprehensive list of the local contracting companies. Drawing a representative sample from this frame is suitable for this research as every contractor in Kuwait needs to be registered with CTC. Without registering with CTC, the contractor cannot be involved in the tender process for any public project. More importantly, any contracting company regardless of its size needs to be registered with CTC before being involved in any work in the industry. Otherwise, the contracting company is considered to be working illegally without the permission from the relevant governmental entity (CTC) and would be highly penalised.

The list provided by CTC includes contractors classified against different categories ranging from category 1 to category 4. Category 1 companies are required to have a capital of KWD 0.5M (USD 1.66M), category 2 are required to have a capital of KWD 0.2M (USD 0.66M), category 3 are required to have a capital of KWD 0.1M (USD 0.33M) and category 4 are required to have a capital of KWD 50K (USD 150K) as required by CTC (2016). The categorisation of the contracting company would dictate its eligibility to participate in the tendering process of different types of governmental projects. In other words, the types of projects conducted by these companies would vary based on its categorisation. The total population is 496 contracting companies in Kuwait through which a representative sample was drawn from.

According to the CTC (2016), there are 78 contracting companies classified in category 1; 187 in category 2; 231 in category 3 and 841 in category 4. The categorisation of the contracting companies is primarily based on the company's capital in addition to other criteria that is related to the contractor's capability to undertake projects such as number of employees and logistics (CTC, 2016). Jarkas & Bitar (2012) had the same targeted population for this research (contractors in Kuwait) and used the random sampling technique. This technique ensured that all the samples have an equal chance to be selected and studied within the research (Jarkas & Bitar, 2012). Since their research was conducted in Kuwait and focused on the same population of this study, the random sampling technique was utilised in this research.

Since this research required the collection of data from individuals working within contracting companies, a specific criteria was needed to select the participants who adds value to the data collection process and would ultimately contribute to achieving the research objectives. The CTC website provides contact information and addresses of all the registered contracting companies. This information was used for reaching out to several companies within different categories. The choice of which companies to contact was partly related to the reputation of these companies based on the experience of the researcher. Well-known and highly reputed companies in Kuwait are known for their high performance in project management and their willingness to contribute with their experience to research. Nonetheless, some of the contracting companies in category 3 and 4 were selected randomly based on their willingness to participate in the research. Since all the companies selected by the researcher were registered with CTC, they were considered to be a good choice as a representative sample for the wider population of contractors within different categories in Kuwait.

To approach all these participants, the author visited the HR department for different contracting companies and requested the contact information of potential participants that would fit the criteria of each research stage. After the contact information was provided, the availability of the participants and their willingness to contribute to the research (given that they fit the sampling criteria) was the determining factor of being involved in the data collection. The participants were made aware of the time necessary for the interview or survey prior to making the decision to participating in the research. They were also informed about the potential future commitments in the case of being involved in the Delphi survey which requires the participants to provide their perspectives through multiple rounds. This ensured that a mutual understanding is reached between the researcher and participants thus facilitating a steady data collection process. Research ethics standards were held throughout the data collection process as highlighted in the research ethics section within this chapter.

Different stages of the research required the involvement of different participants. For instance, the preliminary interviews were exclusively conducted with participants who had a senior position in the contracting company and a minimum of 8 years of experience in the construction industry. The reason behind this sampling choice is that the preliminary interviews aimed to explore and widen the scope of change management by contractors in Kuwait. Therefore, an extensive experience and a managerial position was deemed necessary to gain a proper insight into what constituted the change management process by contractors in Kuwait and to complement the scope of change management process which was already determined by the literature.

At that initial stage, interviewing participants with less experience would have been non-value adding as they are as involved or experienced in the project management domains and processes as the participants holding senior positions within the contracting company.

On the other hand, participants with less experience were included within the sample of the questionnaire survey as it targeted the evaluation of the change management processes from the wide spectrum of perspectives. The junior participants would provide a complementing point of view of the degree of practicality and hands-on effectiveness of these change management processes. In other words, involving participants from different positions within the survey would provide a better and more complete picture of what is truly happening in contracting companies when it comes to managing change.

After selecting the sampling technique, the sample size should be established for the population. To ensure the correctness and robustness of the sample size chosen, diverse formulas were used.

The first step is selecting the suitable level of precision otherwise known as sampling error to highlight the difference between the estimated statistics and the true population parameter (Jupp, 2006). Sampling error is widely influenced by the utilisation of non-probability sampling, insufficient sampling frames and the lack of responses by the sample (Walliman, 2006). Jarkas & Bitar (2012) used a sampling error of ±5% for conducting the research concerning about labour productivity in Kuwait that involved the same populations used in this research (the four categories of contracting companies).

Therefore a sampling error of ±5% was reasonable for this study. Next, the confidence level should be determined. A confidence level of 95% is considered suitable in the assumption of a normal distribution in the population (Israel, 1992). To reduce the risk of the sample's lack of representation, a confidence level of 99% could be used (Israel, 1992). Nonetheless, it is recognised from the literature review that a confidence level of 95% is more widespread and is sufficient for both sampling and data analysis purposes (Perkins, 2009; Zou & Lee, 2008; Love *et al.*, 2002; Chan & Kumaraswamy, 1997).

Another factor influencing sample size calculation is the degree of variability. A conservative value of 50% is frequently used to indicate the biggest possible variability in the population and would result in a bigger sample size (Sincich *et al.*, 2002; Israel,1992). This would properly serve the purpose of this study through covering the variability in the different contracting companies categories and even the implicit perspectives of best practices and tools to be used in managing change in Kuwait. This research used the formula developed by Kish (1995) which is shown below. Where n_o is the first estimate of sample size, q is 1-p, V is the maximum error allowed. From this formula, the sample size is $n \approx 83$.

$$n_0 = \frac{p.q}{V^2}$$

$$n = \frac{n_0}{1 + (\frac{n_0}{N})}$$

5.6.4 Data collection procedure

After the determination of the sampling strategy and sample size, the data collection process design process is initiated. The data collection process aims to extract the perspectives, experiences and knowledge of contractors on the integration of change management in their companies and the challenges that they are facing in the different stages of managing the project change. The preliminary interviews was be used to expand on the list of discovered change management practices and tools which were discovered from the previous literature review in addition to roughly outlining the change management practices and tools used by contractors in Kuwait to guide the creation of the questionnaire survey. The questionnaire survey targets the wider population of contractors in order to establish the successful criteria of change management in Kuwait as a main concern in addition to other relevant aspects.

5.6.5 Preliminary Interviews

The data collection process started with conducting a pilot study in the form of qualitative semi-structured interviews. The preliminary semi-structured interviews contributed to improving the depth of the research through exploring how contractors in Kuwait currently manage change. The interview complements the conducted literature review by confirming the utilisation extent of the previously established change management processes acknowledged in previous publications, the effectiveness of these processes and highlight additional change management related processes used by contractors in Kuwait. Therefore, the interviews assured the alignment of the literature review in relevance to the Kuwaiti construction industry.

The preliminary interviews were conducted with five professionals working in different contracting companies in Kuwait. The interview questions are grouped under two section. The first include questions about the background of the interviewees while the second part uses fifteen questions that would focus on the application of change management in the Kuwaiti construction industry. And since the collected qualitative data is represented in the form of words, certain steps were illustrated to analyse this type of data by Walliman (2006) & Creswell (2009). These steps essentially depend on the organisation of data for analysis, familiarisation and examining the context of this data, using the coding process, exploring and/or developing themes, discussing the themes recognised and finally the interpretation of the results. The researcher should interpret the results based on sound reasoning since this is the basis to convince the reader of the research output and to answer the research questions (Walliman, 2006).

The questions focused on the conducted processes and encountered problems related to change management by contractors in Kuwait. Understanding these aspects is critical to recognise the used approaches limitations and discuss potential improvements with the interviewees. The discussion in the interview was steered to enable maximum exploration in the discussed case itself (i.e., whether a particular change management aspect is implemented in a beneficial way, the limitation of the aspect discussed and the potential for improving the aspect itself to be more suitable for the contractor thus improve the change management performance). This way, the interview would feature a deeper discussion in particular and relevant areas rather than being generic, shallow and irrelevant to the case in hand.

The preliminary interviews optimised the design of the subsequent questionnaire survey and enable the author to further explore the utilisation of the specified change management processes of contractors in Kuwait. As a result of the preliminary interview, the questionnaire survey would brief and tailored to the industry which could potentially increase the response rate.

5.6.6 Questionnaire survey

A quantitative questionnaire survey was used with the aim of obtaining the view of contractors and create the full picture of what constitutes successful change management processes in Kuwait. The questionnaire highlighted the successful practices within a comprehensive list of change management processes which was generated from the output of the preliminary interviews in conjunction with the formerly conducted literature review. Additionally, The questionnaire allowed contractors to extend the list through adding further successful processes. The verification of processes is based on the frequency through which each practice and tool is used in the project to manage change from the perspectives of the respondents. The verified change management practices and tools were later on grouped under Key Process Areas (KPA's) and used as the improvement criteria in CMCMM.

First, it is essential to properly design the questionnaire survey. A research design is represented by the plan of the research that would potentially assure the generalisation and representation of the finding and drawn conclusions (Saris and Gallhofer, 2007). The questionnaire design should illustrate the selected sample and sampling technique, pilot survey questions and full survey questions (Oppenheim, 2000). The questionnaire design is completed when the full survey questions are finalised and ready to be disposed to the respondents.

Sampling should be used to choose representative groups from the population (Jupp, 2006) and avoid misleading interpretation and representation of the collected data (Walliman, 2006). Therefore, a list of all units of the population known as the sampling frame (Jupp, 2006) should be first established to select the sample from. The sampling frame used in this study is provided by Kuwait's Central Tenders Committee (CTC) website which shows a comprehensive list of the local contracting companies. For this study, the project teams and individual professionals were considered as the research subjects which would in turn provide the author with an enhanced insight and better accuracy when it comes to satisfying the relevant research objectives.

A pilot survey was conducted with five professionals working in different contracting companies to test every aspect of the questionnaire and revise it if needed prior to sending the questionnaire to all the units of the selected sample. These individuals were not the same individuals who participated in the preliminary interviews. The pilot also serves the purpose of observing the potential response rate when conducting the full survey study. Feedback on the questionnaire content was requested from the contractors to improve the necessary sections prior to conducting the full survey. The results from the sample who received the pilot survey were eventually added to the study as there were no revisions necessary.

It is vital to secure an acceptable response rate for the questionnaire survey to succeed in the previously calculated sample size. Ideally, a 100% response rate would include the entire sample which would reduce the risk of decreased validity of the data collected (Jupp, 2006).

The survey was sent online and filled face to face to ease the process of data collection amongst the participants. An additional advantage of online surveys is that it eliminates manual data entry thus eliminating the risks of incorrect entry. Oppenheim (2000) suggests that the researcher should explain why the completing the survey is significant to the body of knowledge in addition to assuring that complete confidentiality is sustained.

The full survey was then conducted and the collected data was analysed to extract findings and conclusions. The survey included eight sections which mostly required the participant to indicate their perspective on a Likert scale. The fist part was focused on the background information of the participant including role, years of experience, contracting company category and types of project the participant was involved in. The next five part dives into enquiring about the usage frequency of change management practices and tools related to promoting a balanced change culture, identifying change, evaluating change, monitoring and controlling change and continuous improvement within the participant’s organisation. The seventh part focused on the degree of involvement of different stakeholders within the change management process while the last part of the survey focused on the frequently encountered issues in the change management process. On this basis, the survey provided a rather comprehensive picture of the currently used change management processes in Kuwait and the encountered issues.

The data was analysed using different techniques in order to comprehend what the data was trying to say. Univariate analysis such as the frequency distribution was used to indicate the frequency of a particular variable across the sample in the form of a number and a percentage of the total. Central tendency was measured to indicate the mean value of the variable and would include the calculation of the arithmetic mean. Dispersion was also measured to indicate the extent of variability in the values and indicate the extreme values through calculating the range, Interquartile range, variance, standard deviation and standard error. The results of the univariate analysis would contribute to the recognition of the successful and unsuccessful change management processes of contractors. This would later on would be used to create the evaluation criteria of CMCMM. It is worth mentioning that the usage of mean throughout the research has its limitation. Most importantly, extreme values in the data can distort the result and provide an incorrect picture as the mean is very sensitive to outliers and skewed distribution.

5.6.7 Analytic Hierarchy Process (AHP)

The results of the survey constitutes the successful change management processes and tools as perceived by contractors in Kuwait and forms the basis of generating the improvement criteria of the model. This model is distinguished in a way that assigns weight to these criteria to reflect their significance in the perspective of contractors in Kuwait. Therefore, the Analytic Hierarchy Process (AHP) was used to extract the weightings of the model's improvement criteria to indicate the real value of each criterion in managing project change for contractors in Kuwait.

An AHP panel of eight participants was consulted through individual face to face interviews about the relative significance of the identified change management success factors for contractors in Kuwait. These meetings were individual since it is practically impossible to schedule one meeting for all the participants in one timing in addition to limiting the influence of the participants on each other since this process requires a qualitative judgement.

The Analytic Hierarchy Process (AHP) method was developed by Saaty (2001) and it aims to facilitate the complex decision making with multiple criteria in qualitative research. Decision makers would use their intuition in determining the relative significance of different criterions based on their significance. Next, the decision makers compare between different elements based on the previously weighted criteria. The final score is the known as the weighted average and can be used in ranking the possible decision outcomes (Sowlati *et al.*, 2005).

AHP is a measurement method underpinning mathematical and psychological aspects (Bhushan & Rai, 2007) and is optimally used in research where a large sample is not necessarily required (Lam and Zhao, 1998). The major steps of the multiple-criteria decision-making (MCDM) process utilised through AHP were previewed by Bhushan & Rai (2007) and included:

- Understanding the set of circumstances
- Structuring multiple criteria
- Evaluating multiple criteria
- Evaluating alternatives according to the criteria
- Ranking the alternatives
- Integrating the judgement of involved experts in the matter

Data is collected by requesting the participants to set their preferences using a qualitative scale known as the AHP scale (Bhushan & Rai, 2007) and should indicate the preference of the compared change management processes significance as shown in figure 5-5. These responses would later on would be compiled to form a ranking for the change management processes.

	Extreme		Strong		Moderate		Weak or Slight		Equal	Weak or Slight		Moderate		Strong		Extreme	
Element 1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Element 2

Figure 5-5 AHP scale

Next, the results would be organised into a square matrix as shown in figure 5-6 which would compare between the significance of different elements (X, Y and Z for this instance) from the participant's perspective. The diagonal elements of the matrix is naturally equal to 1. This is due to these elements representation of comparing each criterion to itself (i.e., comparing the importance of sustainable considerations with sustainable considerations in a design). If the element value of element (i, j) is more than 1, this indicates that criterion in the ith row is better than the criterion in the jth column. On the other hand, if the element value of element (i, j) is less than 1, this indicates that criterion in the ith row was less prioritised than the criterion in the jth column. Additionally, the (j, i) element of the matrix is always the reciprocal of the (i, j) element as mentioned by Bhushan & Rai (2007).

	X	**Y**	**Z**
X	1	9	3
Y	1/9	1	5
Z	1/3	1/5	1

Figure 5-6 AHP matrix

The following step would be to generate the eigen-vector of the matrix and indicate the relative importance of the criteria being compared. The eigen-vector is then normalised and the elements of the vector are named weights when it comes to determining the importance of the criteria. Finally, the consistency of the resulting weights is tested to account for the subjectivity of the approach within the limits of AHP tolerance. Failing in the consistency test will necessitate relapsing the same process again till an acceptable consistency is obtained. The consistency test starts with finding the matrix order (number of rows and columns used) which is denoted by n. Additionally, λ_{max} which is the principle Eigen value should be found. According to Bhushan & Rai (2007) following equation could be used to find the consistency index (CI):

$$CI = (\lambda_{max}-n)/(n-1)$$

The CI found should be then compared to a random consistency index (RI) which is based on the random matrix. RI is given by different studies depending on the matrix order (n) as shown in table 5-7. CI/RI which is known as the consistency ratio (CR) should be less than 0.1 (10%) according to (Saaty, 1980). Otherwise, the subjective opinion is considered inconsistent and cannot be considered as trustworthy.

Table 5-7 Random Consistency Index (RI) for "n" number of elements

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.48	1.49

The following point of focus should be on aggregating the opinions of various individuals participating in the weighting of the criteria to get a wholistic weighting to be used in the study. This is necessary in this research since a group of interviewees are required to participate in the prioritisation process through the AHP scale. Therefore, a single set of criteria weighting should be generated (Regan *et al.*, 2006).

Xu (2000) states that the most common and practical route to aggregating the group weighting is using a summarised AHP weight across the group. This method entails that all the weights extracted from the participators are added to determine which weight has the highest mean value and then rank the criteria accordingly. Using AHP for ranking different criteria was pointed out as primal usage of the method by Saaty (2003). The result of this step was the weight assignment to the change management practices which were prioritised by the AHP panel. Through aggregating opinions, this weighting carries the perspective of all the professionals that have a role in the AHP panel.

The AHP output sets the basis of creating a weight for the improvement criteria of the created model. Not all practices represent the same significance in the real project setting therefore the change management maturity assessment should reflect the varying range of these sub-criteria significance. Based on this input, the first version of the change management model is created.

5.6.8 Principal Component Analysis

Since the upper limit is often nine alternatives within each alternatives comparison within the AHP process (Miller, 1956), a technique is needed to create a group with nine criteria or less to ensure that meaningful results are concluded. A multivariate data analysis technique known as the principal component analysis (PCA) was used to reduce the dimensions to a more practical number which is suitable for the AHP process.

The basic use of principal component analysis is to compute the most relevant basis to re-express a noisy data set (Shlens, 2014). PCA is successful in reducing the dimensions yet preserve as much information as possible from the original data (Francom & El Asmar, 2015) thus simplify the data structure the researcher is dealing with (Shlens, 2014). The

PCA method would find the linear combination of the original data, the uncorrelated data and that variation within the dataset (Cox, 2005). The outcome of PCA would be a list of Principal Components (PC) that represents the data to a high degree through less dimensions.

Prior to starting the dimension reduction process, the data set needs to be tested for adequacy prior to starting the PCA process in order to extract useful and meaningful results. The KMO value should be above 0.5 for the data set to be deemed adequate for the use of PCA (Child, 1990 and Field, 2005). The Bartlett's test of sphericity is also needed to confirm that the population of the dataset is not considered and identity matrix in order to be able to proceed to the PCA process (Dogbegah *et al.*, 2011).

The researchers capability of understanding the PCA output is improved by rotation (Norusis, 1988). The role of the Varimax rotation is to ensure that the squared loadings of the items on the components is either large or close to zero with minimal intermediate values. The components would then be extracted based on their contribution to the cumulative variance of the datasets. This would clarify the necessary number of components that represent the originally collected data. Components with total sums of squared loading of more than 1 would be retained to represent the dataset (Kaiser, 1960). The scree plot is also used to support and confirm the decision of number of retained components (Jupp, 2006).

The loading of each variable on the extracted components is then determined. The variables loading is the influence of this variable on the observed component and is represented by the Pearson's correlation between each item and the component. The range of correlation is between +1 and -1 with 0 representing the total lack of correlation. The higher the correlation is the better the variable's degree of representation by the extracted principal component.

It is important to check that all the principal components within the matrix have more than one variable landing on them in order to keep all the components. Otherwise, the component would be deemed unfit to reduce the dimensions of the data set.

5.6.9 The Delphi Technique

Using the Delphi technique in conjunction with the AHP process has been proven successful in previous studies (Byun, 2001) where the Delphi technique would collect data through multiple iterations till reaching an acceptable degree of consensus between the participants (Taleai & Mansourian, 2008). This technique entails that the participants would receive feedback after submitting their responses to rethink their initial judgements based on their review of the previous iteration's results. This process is typically repeated for three to four times to reach consensus (Zhu, 2011; Sharma *et al.*, 2003). It is recognised that any extreme values are decreased when running several iterations as the participants would be positively influenced by the anonymous feedback and would reconsider their judgments.

The incorporation of Delphi technique with AHP requires repeating the AHP process after the distribution of anonymous feedback to the survey participants and allowing them to reconsider the criteria and revise the rating of the compared elements significance (Tavana *et al.*, 1993). To overcome any unwanted influences of group interactions or having outspoken participants, it is best to collect anonymous information by either email or individual interviews rather than collecting information though a group meeting of all the participants (Kim et. al, 2013). Conflicts and group pressure related issues are eliminated through this approach (Loo, 2002) in addition to having anonymity which adds a certain element of creativeness to the process and richness to the collected data (Delbecq *et al.*, 1975). Most importantly, the amount of encountered coordination efforts and prolonged preparations are reduced through collecting the data from the participants individually thus reducing the cost and duration of the research (Loo, 2002).

To conclude the Delphi iterations, an acceptable consensus must be reached amongst the AHP participants. To recognise the degree of consensus as acceptable, the agreement on the significance of a certain element should be 50% or higher (Olawale & Sun, 2015). This approach of identifying consensus as adequate was confirmed to be successful when using ordinal data (Gracht, 2012). The coefficient of variation (CV) can be used to indicate the degree of consensus reached by the decision makers (Kim *et al.*, 2013) where CV is the standard deviation divided over the mean value. Therefore, there would be no need for an extra round of data collection when CV is less than 50% (Dajani *et al.*, 1979). Other methods were reviewed prior to choosing the coefficient of variation for consensus calculation in the AHP process. Such methods included the consensus calculator suggested by Goepel (2013) which classifies consensus from a range of very low to very high.

Nonetheless, there is no theoretical basis or testing for this method of calculation. Additionally, the method used in this research provides a more accurate consensus calculation through calculating CV for each factor and understanding the overall consensus degree for this particular factor. To the opposite to the approach adopted by Goepel (2013) which indicates consensus per matrix thus providing a less accurate view of which factors in specific were lacking consensus and which had high consensus between the participants. Therefore, CV was used to comprehend the level of agreement and confirm the consensus in determining the significance of the 52 change management criteria within this research.

5.7 CREATING THE CMCMM

Based on the previously collected data, a capability maturity model was developed and validated. A robust process took place and the CMM development framework utilised by Salah *et al.* (2014) was used to ensure optimum validity and practicality. The model application and verification follows the two-stage framework developed by Salah *et al.* (2014). After conducting a literature review in the previous chapter, this framework proved to be both extensive and rigorous to ensure that the model is optimised to the highest level of validity and fitness for purpose. This framework starts with an expert review which followed by conducting a case studies. These two stages are defined as domain experts evaluation and practical setting evaluation. The framework assured that model improvement criteria and representation are truly value adding and tailored to the needs of the contractor in regard to change management.

As a result, this stage featured the development of the initial version of Change Management Capability Maturity Model (CMCMM) that was later on verified and appraised for its effectiveness and suitability for use by contractors in Kuwait. CMCMM was built following the attributes of the popular CMMI and utilises similar terminology such as specific and generic goals and practices and process areas in addition to employing the continuous representation that allows to measure the capability of different process areas rather than providing an overall organisational maturity.

The specific practices were extracted from the questionnaire survey. The weighting of these practices was generated from the aggregation and analysis of views delivered from the AHP panel. These specific practices were grouped according to the change management stages previously reviewed. These stages were considered the Key Process Areas (KPA's) in the model. The advantage of using the change management stages as KPA's in CMCMM is that the model is fully focused on what matters in change management success rather than being distracted by other generic practices as featured in other models.

When it comes to the generic goals and practices, CMMI shows a detailed description of these model components which are necessary to the standardisation and refinement of the domain. These same practices were used in CMCMM in order to increase the change management capability in the organisation since they target the standardisation, refinement and tailoring of the process regardless of the domain's specific practices.

The continuous improvement representation was used since capability levels are more precise to indicate the capability to perform a particular domain rather than overall performance of the organisation. The capability levels specified in the CMMI was used in CMCMM to indicate the capability of contractors in the different process areas. The CMMI capability levels are proficient in indicating the gaps in the change management capabilities and correspondingly focus of organisational improvement efforts should be directed towards. Additionally, these capability levels were further improved through assigning weights to the specific practices of each process area building on the aggregated responses of the AHP panel. Therefore, these weightings increase the accuracy of capability measurement based on the significance of the required change management processes.

5.8 CMCMM VERIFICATION

Constructing a model which is design-oriented (not conceptual) requires a proper verification process (Wendler, 2012). The model verification and evaluation follows the extensive framework pointed out by Salah *et al.* (2014) to ensure optimum suitability of the developed model. First, an expert review known as domain expert evaluation assisted in verifying the validity and practicality of the model according to a specific framework. The usage of the expert review includes a critical perspective on the matter in hand (Fulford & Standing, 2014). The experts assisting in the validation process of this research should have extensive knowledge in the subject of change management. The experts include academics who possess adequate knowledge in the field of project management and continuous improvement processes and procedures within the Kuwaiti construction industry.

Moreover, the experts includes the industry professionals with adequate experience and insight of the potential degree of practicality of the developed model. This combination of experts has optimised the reliability of the developed CMCMM and enhance its ability to indicate and improve the change management capability of the contractors in Kuwait. The expert evaluation should focus on two components of the developed CMM which are the model constructs and evaluation instruments (De Bruin *et al.*, 2005). The instrument typically includes the reference model (CMCMM in this research), performance scale (represented by capability levels) and the assessment procedure through which the organisation's capability is investigated (Salah *et al.*, 2014). The construct is examined for completeness, easiness, interpretation, usability, practicality, effectiveness and influence on the surrounding environment while the model instrument should be tested for soundness and accuracy (March & Smith, 1995).

Following the framework set by Salah *et al.* (2014), experts were asked to elaborate and provide justification for their perspectives on the following matters:

- Modifying the capability levels
- Modifying the capability levels description
- Modifying or omitting specific and/or generic goals and practices
- Modifying the evaluation criteria
- Modifying the assessment process guidelines

- Making the model more useful and practical
- Comments on increasing the value delivered by CMCMM

Next the practical setting evaluation took place to assure the practicality of applying CMCMM through conducting three case studies involving contractors in Kuwait. A step required to ensure that the model is based on empirical methods and are actually valid for usage within their intended scope (Wendler, 2012). The data collected from the case studies should indicate the capability levels of different change management process areas in the contractors' organisations. Based on the experts feedback and the conducted case studies, the final version of CMCMM would be developed and ready to be utilised by the contractors in Kuwait. Additionally, an overview of the aggregated capabilities of the organisations was created to provide an idea of the current situation of change management processes in Kuwait and supply the research recommendations accordingly.

5.9 RESEARCH ETHICS

Every research should be built on a sound ethical ground. It is essential to collect, analyse and interpret data in an ethical manner as discoveries can only be valuable if a research is conducted in an honest manner (Walliman, 2017). Research ethics is particularly important when involving human participants in the data collection process (Walliman, 2017). Participants should be treated with respect through preserving confidentiality, anonymity within the data collection and throughout the research.

Due to the significance of conducting research ethically, formal ethical requirements are considered standard in the process of publishing in scientific journals (Kjellström *et al.*, 2010).

Similarly, universities do require their research students to sign an ethics approval form prior to the data collection process to ensure an appropriate ethical foundation for the research. The researcher has received ethical approval from the researcher's institution as a prerequisite for conducting this research. This approval was specifically from the School's Ethics subcommittee and Head of School / Director of research. The ethical approval form is attached in Appendix C. The ethical guidelines highlighted in the postgraduate research student code of practice of the researcher's institution were strictly followed throughout the different stage of this research.

5.10 SUMMARY

This chapter previewed the research and methodology utilised in this research. In order to satisfy the research objectives, this chapter started with reviewing the different research philosophies, approaches, methods and techniques as found in the literature. The aim was to assure this research incorporates the most suitable methodology in order answer the research question. This review followed the research onion developed by Saunders *et al.* (2012) to ensure all the layers were addressed. Based on the review, this study uses the constructivism and interpretivism philosophical stances and the inductive approach. The qualitative research design was deemed most suitable in this research based on the exploring nature of the research objectives.

The chapter also considered the conduct of semi-structure interviews of contractors in Kuwait. The following step is to conduct qualitative analysis and identify the best practices of change management of contractors in Kuwait. These practices later sets the foundation of CMCMM which evaluates the change management capability of contractors. That would be in addition to using AHP define weights of and the prioritisation of change management best practices which is also reflected in the model itself. The model validation and evaluation follows the extensive framework pointed out by Salah *et al.* (2014) to ensure optimum suitability of the developed model. Initially, an expert review assisted in verifying the validity and practicality of the model according to a specific framework. This step is known as the domain expert evaluation. Next the practical setting evaluation took place to assure the practicality of applying CMCMM in the reality through conducting three case studies involving contractors in Kuwait.

CHAPTER 6 - CHANGE MANAGEMENT PROCESSES IN KUWAIT

6.1 INTRODUCTION

This section will focus on exploring the change management processes used by contractors in Kuwait. These identified processes reflect the change management needs of contractors and the prevailing constraints of the contracts used in Kuwait was be used in CMCMM. The scope of change management was understood through the preliminary interviews while the comprehensive components of the developed model was extracted from the subsequent questionnaire survey. Qualitative and quantitative analysis of the collected data will also be discussed in this chapter.

6.2 PRELIMINARY INTERVIEW

The questions in the preliminary interview aim to explore the scope of the change management processes of contractors in Kuwait. The scope was explored from two perspectives which are change management stage and the change management dimension as shown in Table 6-1. This approach allowed the author to investigate the attributes of the change management processes and practices in a systematic manner. For instance, one of the questions investigated the tools used in recognising change while another focused on the people involved in change evaluation and their roles. The list of questions in the preliminary interview are shown in Appendix D.

Table 6-1 Preliminary Interview Questions Formation

		Change Management Process Stages				
		Promote a balanced change culture	**Recognise change**	**Evaluate change**	**Implement change**	**Continuously improve from lessons learned**
Change Management Dimensions	**People**	Q1	Q2	Q3	Q4	Q5
	Process	Q6	Q7	Q8	Q9	Q10
	Tools	Q11	Q12	Q13	Q14	Q15

6.2.1 Data collection

The semi-structured interviews were used to explore the topic in a bigger depth and facilitate the drawing of conclusions later on. The questions were related either to exploring more practices, finding out more issues and/or discussing potential improvements. An audio recorder was used during the interviews to ensure that the author would not miss any piece of information and is completely focused on the interview process. A transcribing process was used after the interviews to convert the audio recordings to transcripts that could be analysed.

6.2.2 Interviewees Profile

Four managers and one section engineer were interviewed and provided valuable information about the scope of change management used in contracting companies in Kuwait. The five interviewees were working for five different contracting companies in Kuwait. These companies covered the range of contractors categorisation of the central tenders committee (CTC) which was previously mentioned in the research methodology chapter. Therefore, the interviewees were working in a first, second, third or fourth category contracting companies. Two of these interviewees were working with two different first category companies. The increased focus on first category was based on the fact that increased capabilities and reputation plays a pivotal role in acquiring this categorisations.

Therefore, high calibre management processes in these companies is expected and would provide proper insight into what constitute the scope of change management of contractors in Kuwait. The selection criteria of the interviewees made sure that they would potentially contribute positively to the research objective. This criteria required the interviewee to have extensive exposure to the management processes utilised in the company, a sufficient experience in the industry and the age and reputation of the contracting company. The profile of the interviewees and the contracting companies that they are employed at is shown in Table 6-2. The profile covers position and working experience of the interviewee in addition to the number of employees, age and category of the contracting company the interviewee is employed at. These individuals were personally contacted in order to set suitable meeting timings.

Table 6-2 The profile of interviewees and their companies

Interviewee No.	Interviewee		Contracting Company		
	Position	Working Experience	Number of employees	Age	Category
1	Project Manager	12	400-500	11	2
2	Construction Manager	17	>500	26	1
3	Section Engineer	8	>1000	15	1
4	Project Manager	21	<100	5	4
5	Contract Manager	18	>600	8	3

This sample size was considered adequate after the initiation of the interviews. After the third interview, the researcher realised that the point of data saturation is being approached. In other words, the answers of the interviews are starting to be considered typical and repetitive with no new valuable information to the research scope. This is why the researcher stoped the data collection after completing the five interviews as no new emerging ideas were being presented by the highly experienced interviewees other than what was already demonstrated in the early interviews.

6.2.3 Data Analysis

Structural coding method was used to form codes since is it suitable for qualitative research that includes multiple participants, semi-structured interviews and has the objective to unveil categories and themes within the interviews (Saldaña, 2015). Structural coding systematically contributes to organising data around specific research question (Saldaña, 2015). The data analysis will include thematic analysis and codes frequency to fully understand the collected data and form a clear picture about the scope of change management of contractors in Kuwait.

The analysis of the transcripts was done using two consecutive approaches. The first was dealing with all the transcripts from different interviews as one big document that was coded. This approach provided the researcher with an overview about the content of the interviews but without categorising these codes. The succeeding approach included the review of the questions concerned with one change management stage at a time based on all the transcripts. The grouping included questions concerned with promoting a balanced change culture (Q1, Q6, Q11), change identification (Q2, Q7, Q12), change evaluation (Q3, Q8, Q13), change implementation and monitoring (Q4, Q9, Q14) and continuous improvement in change management (Q5, Q10, Q15). These questions were analysed in their groups in order to understand the current practices, problems and potential improvements in each and every change management stage.

Themes are implicit patterns between the created codes that are recognised as a result of analytic reflection (Saldaña, 2015). Thematic analysis is used to create a theory by finding commonalities and mutual themes between the collected data from the research participants (Jupp, 2006). This research used a process known as the thematic analysis with "bottom up" approach which entails that themes are made up from the data collected (Braun and Clarke, 2006). This would use phrases or sentences to draw themes from the formulated codes with the objective of recognising the scope of change management of contractors in Kuwait. The coding processing showing the usage of the NVivo 11 software is shown in Figure 6-1.

The scope of change management of contractors in Kuwait was explored through three aspects. These aspects are current practices, current problems and potential improvements related to change management. After the aspects of change management of contractors in Kuwait are highlighted, the current practices are discussed in the light of the interviewees statements that were coded in the created node. The initially created first cycle codes are shown in table 6-3. These 64 codes are organised according to their frequency in different references of the interviews transcripts which is shown as "references" in the table.

The table also shows how many sources (interviewees) mentioned these codes. This task was made easy since the codes are represented by nodes in the NVivo 11 software which would in turn identify the frequency of this code in both references and sources. All the practices mentioned at this stage were considered by the researcher as part of the change management scope of Kuwait.

NVivo 11 also allowed the researcher to review the codes, recode, create categories and enable the discovery of themes amongst these codes. Since thematic analysis was used, NVivo 11 also helped in grouping related statements in one node that represents a theme.

The name of the node was initially prepared based on the statements and later on revised to represent the content of each theme in a better way.

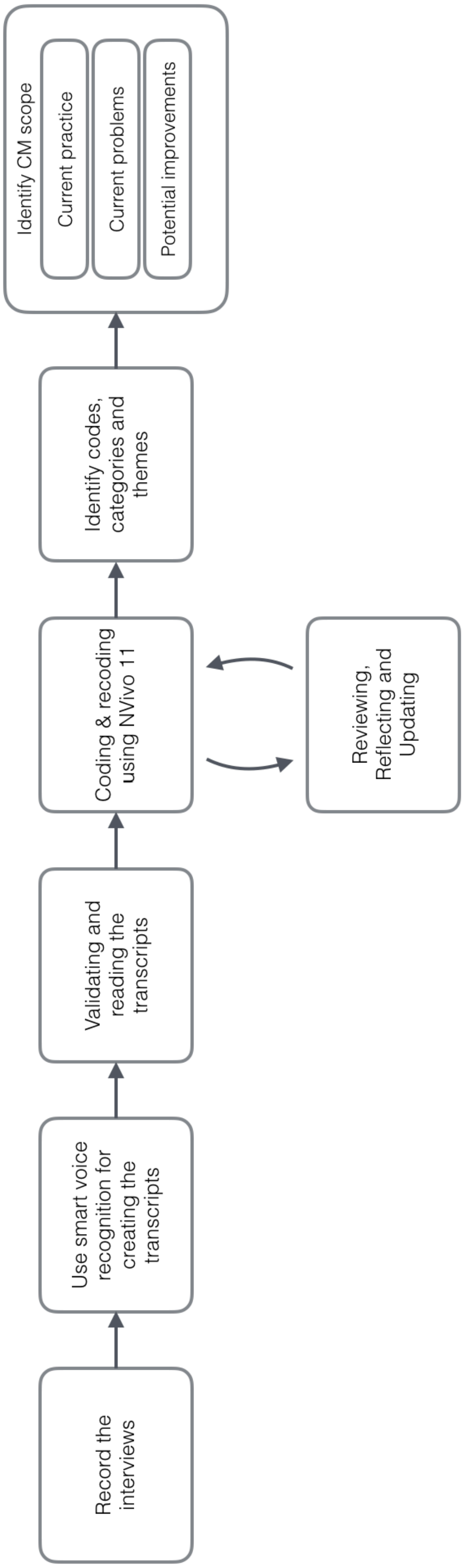

Figure 6-1 Coding process

Table 6-3 Codes generated from first cycle coding

Code	Sources	References
report	5	19
project manager responsibility	3	13
client involvement	5	11
Informal communication	5	10
microsoft excel	5	9
communication through email	4	8
standardisation level	4	8
no process	4	7
contract requirements	4	6
share experiences	4	6
site engineer responsibility	4	6
supply chain responsibility	4	6
policy	5	5
database	4	5
Training	4	4
risk management	3	4
smartphone app group	3	4
limited information	3	4
BIM	2	4
change log	1	4
Quantity surveyor responsibility	3	3
evaluation criteria	3	3
inadequate risk evaluation	3	3
scheduling manager responsibility	2	3
lack of collaboration	2	3
lack of preparation	2	3
change description	2	2
design team	2	2
management responsibility	2	2

no standard process	2	2
project by project basis	2	2
project director responsibility	2	2
section engineer responsibility	2	2
site staff	2	2
repeated mistakes	2	2
meeting	1	2
monitoring frequency	1	2
training provided	1	2
spreadsheets limitations	1	2
PMBOK	1	2
web-based content management system	1	2
change order	1	1
change request	1	1
contract manager responsability	1	1
formal communication	1	1
lack of change prediction	1	1
lack of funding	1	1
lack of training	1	1
learning by experience	1	1
mainstream process	1	1
new comers orientation	1	1
periodic review	1	1
quick solutions	1	1
share successful experiences	1	1
spreading awareness	1	1
transparency	1	1
value management	1	1
lack of leadership	1	1
training limitation	1	1
work overload	1	1

awareness emails	1	1
change prediction tools	1	1
improve communication	1	1
proper documentation	1	1

Consequently, these codes were refined, merged and often deleted after reviewing the codes through NVivo 11 charts, mind maps and nodes comparison thus commencing the second coding cycle. New codes were also generated after several reviews of the created codes. The codes were then sorted in a hierarchy of nodes to make sense of the collected data and recognise the arising themes between these codes. As a result, six themes were identified as illustrated in the form of a hierarchy of nodes as shown in figure 6-2. The themes identified were promote a balanced change environment, identify change, evaluate change, implement change, continuous improvement and organisational standardisation. These themes act as an umbrella for underlaying codes that were discovered throughout the coding process.

Table 6-4 shows how frequently the codes' usage within each of these six themes. For example, the "promoting a balanced culture" theme features 27 codes that are identified in the interview transcripts by using NVivo 11. Therefore, this table 6-4 acts as a summary of the subsequent tables and provides an overview of the total code frequencies prior to investigating these codes in detail.

Table 6-4 Code usage frequency across the discovered themes

	Code Usage Frequency
Promote a balanced change culture	27
Identify change	36
Evaluate change	52
Implement change	45
Continuous improvement	25
Organisational standardisation	24

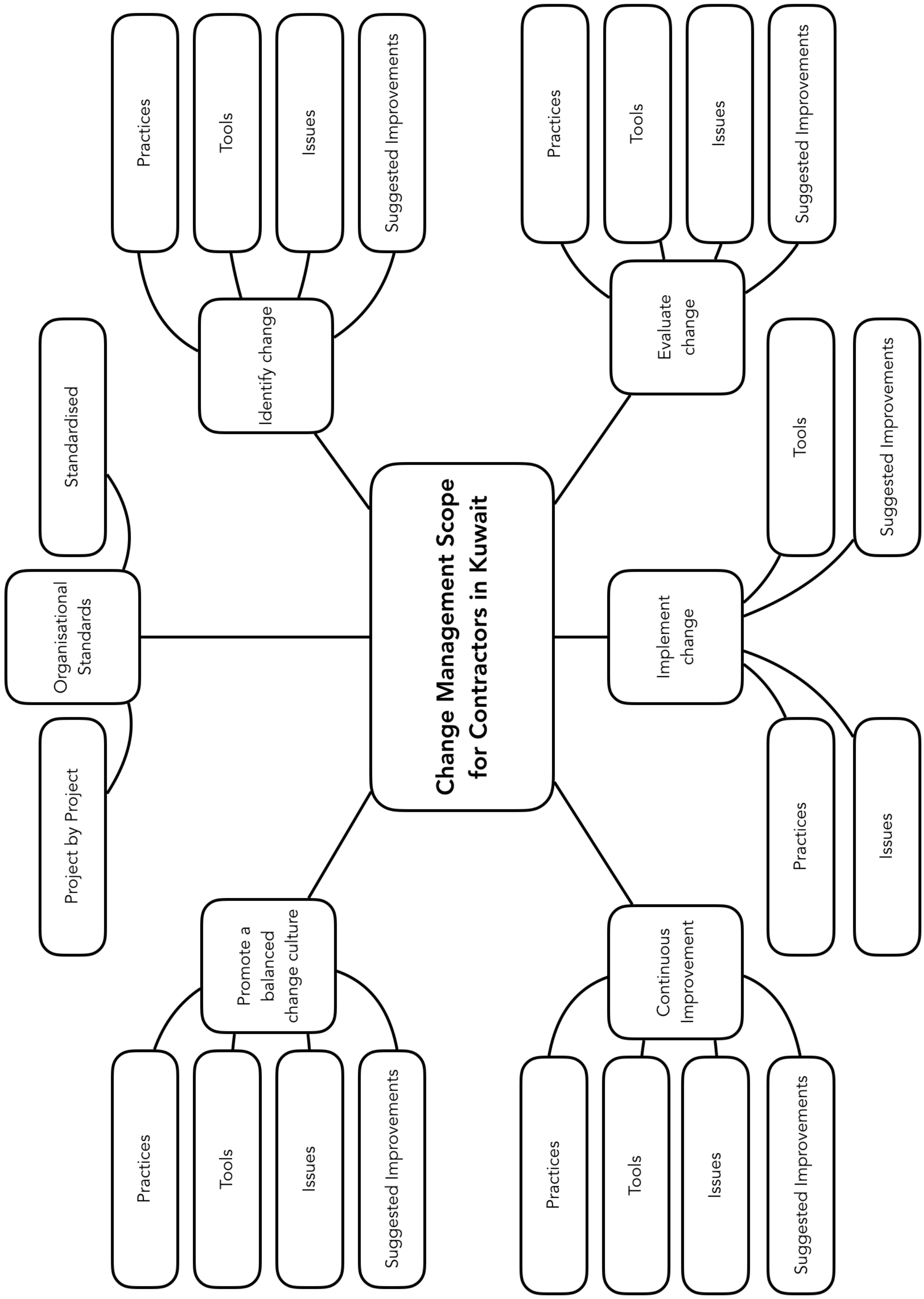

Figure 6-2 Hierarchy of the NVivo 11 nodes

Tables 6-5, 6-6, 6-7, 6-8 and 6-9 provide a deeper view through showing the frequency of codes usage under the different code groups including current practices and tools, current issues and potential improvements to form the themes. For instance, the code “change log" was mentioned twice under practices and once under the tools for the “promote a balanced change culture” theme. These final codes were produced after the previously mentioned process of coding and recoding in order to ensure that these codes are as refined and representative of the data corpus as much as possible.

Table 6-5 Codes matrix in NVivo 11 featuring the "promote a balanced change culture" theme and underlaying codes

	Practice	**Tools**	**Issues**	**Suggested improvements**
Change log	2	1	0	0
Contract	3	0	0	0
Database	0	0	0	3
Email	0	2	0	0
Evaluation criteria	2	0	0	0
Lack of preparation	0	0	3	0
Project by project basis	1	0	0	0
Repeated mistakes	0	0	1	0
Sharing previous experiences	2	0	0	0
Training	2	0	3	2

Table 6-6 Codes matrix in NVivo 11 featuring the "identify change" theme and underlaying codes

	Practice	**Tools**	**Issues**	**Suggested improvements**
BIM	0	0	0	1
Change prediction tools	0	1	1	1
Collaboration	2	0	0	0
Contract	1	0	0	0
Database	0	1	1	1
Email	2	2	0	0
Lack of change prediction	0	0	1	0
Meeting	1	0	0	0
Memo	4	0	0	0
Reporting	5	1	0	0
Smartphone app group	0	1	0	0
Spreadsheets	1	2	1	0
Spreadsheets limitations	0	2	1	1
Training	0	0	0	1

Table 6-7 Codes matrix in NVivo 11 featuring the "evaluate change" theme and underlaying codes

	Practice	Tools	Issues	Suggested improvements
BIM	0	0	0	2
Collaboration	12	0	0	0
Contract	2	0	0	0
Email	0	1	0	0
Evaluation criteria	1	0	11	0
Memo	1	0	0	0
Project by project basis	0	0	1	0
Proper documentation	0	0	0	1
Reporting	1	0	0	0
Risk management	2	2	0	0
Sharing previous experiences	1	0	8	0
Spreadsheets	4	1	0	0
Spreadsheets limitations	0	0	1	0

Table 6-8 Codes matrix in NVivo 11 featuring the "implement change" theme and underlaying codes

	Practice	Tools	Issues	Suggested improvements
BIM	0	0	0	1
Change log	1	0	1	0
Collaboration	4	0	0	0
Contract	1	0	0	0
Email	1	2	0	0
Meeting	1	1	0	0
Reporting	17	5	0	1
Risk management	1	0	0	0
Smartphone app group	0	2	0	0
Spreadsheets	2	2	0	0
Web-based content management system	1	0	0	1

Table 6-9 Codes matrix in NVivo 11 featuring the "continuous improvement" theme and underlaying codes

	Practice	Tools	Issues	Suggested improvements
Awareness emails	0	0	0	1
Change log	2	0	0	0
Charing previous experiences	5	0	0	0
Database	0	0	0	1
Evaluation criteria	5	0	0	0
Improve communication	0	0	0	1
Lack of collaboration	0	0	3	0
Lack of leadership	0	0	1	0
Project by project basis	1	0	0	0
Repeated mistakes	0	0	1	0
Training	0	0	0	1
Web-based content management system	0	0	0	1
Work overload	0	1	1	0

Table 6-10 Codes matrix in NVivo 11 featuring the "organisational standardisation" theme and underlaying codes

	Organisational standardisation
Contract	1
Evaluation criteria	1
Project by project basis	18
Sharing previous experiences	1
Standardised	3

The emerging themes in the transcripts were comparable and in alignment with the stages of the change management previously stated in this research. The reason is that the questions of these interviews were formed based on the literature review and to investigate the scope of change management in further detail. Therefore, these questions enabled the interviewees to reflect their knowledge and experience within particular aspects that align with the change management stages and provides more depth and relevance to the Kuwaiti construction industry. Using these stages as categories made sure that the discovered codes could be grouped systematically according to the relevant stage which was beneficial for analysing the transcripts. For instance, all the tools used (according to the perspectives of different interviewees) in change evaluation was grouped under a mutual node which enabled the researcher to observed the similarities and differences between these tools in a systematic fashion.

6.2.4 Coding sample

In order to provide an insight about the coding process conducted, the following sample shows the statements coded under the "change evaluation" node. The following coding sample will show statements of the interviewees and their opinion in this matter and provide an inside view about the current practices, used tools, current problems and potential improvements as previewed in node/theme used in Nvivo 11. The "reference" is the text coded under the node itself while the coverage is the percentage of the coded text out of the entire transcript. The coverage percentage would be higher if the text coded has a higher word count. The following sample shows the how these coded texts are related to the preliminary interview respondents through indicating the "P.I. Response" number to indicate the different respondents.

<u>Internals\\Preliminary Interviews\\P.I. Response #4 - § 9 references coded [9.07% Coverage]</u>

Reference 1 - 1.34% Coverage

The process of change evaluation depends on the experience of the project manager and project team in addition to considering variation clauses with the client if variation was permitted.

Reference 2 - 1.46% Coverage

The project team shares their experience to thoroughly review the feasibility of change prior to permitting it in the project.

Reference 3 - 0.82% Coverage

Sometimes, the client would be involved to know the feasibility of changing the BOQ or extending the schedule.

Reference 4 - 1.32% Coverage

If there are changes on the delivery dates of the needed material, the impact of this change is evaluated with the project manager with the assistance of the scheduling engineer.

Reference 5 - 1.16% Coverage

Sometimes, if the change means additional cost, the project manager would contact the supplier to get the closest estimation for the additional material.

Reference 6 - 1.32% Coverage

Improvement comes with experience in our company not by a particular process. This goes for all the team members starting from the project manager all the way to the site engineer.

Reference 7 - 0.55% Coverage

Sometimes Microsoft excel is used when the quantity surveyor is involved

Reference 8 - 0.74% Coverage

Sometimes we do risk analysis but not at an advanced level to understand what could possibly happen.

Reference 9 - 0.36% Coverage

For the risks analysis we also use an excel sheet.

<u>Internals\\Preliminary Interviews\\P.I.Response #1 - § 6 references coded [3.56% Coverage]</u>

Reference 1 - 0.27% Coverage

share whichever processes are actually successful

Reference 2 - 0.30% Coverage

Contractors or suppliers may be contacted in this matter.

Reference 3 - 0.51% Coverage

Other than that, I refer the quantity surveyor in order to see what is the cost effects of the change.

Reference 4 - 0.44% Coverage

To improve the cost estimation we may contact suppliers or subcontractors if needed.

Reference 5 - 0.64% Coverage

This process should be documented in a correct way to be shared among other project managers conducting similar projects.

Reference 6 - 1.40% Coverage

Microsoft excel is the only tool to evaluate changes in the project directly of previous in the project could be very beneficial. It feels like it is very limited way to understand the implications off the change on the project aspects whether it was time, cost or quality.

<u>Internals\\Preliminary Interviews\\P.I.Response #2 - § 9 references coded [6.10% Coverage]</u>

Reference 1 - 0.47% Coverage

Clients are made aware that unnecessary changes may imply big cost and time variations.

Reference 2 - 0.73% Coverage

The project team is also made aware of what possible negative changes may be encountered and how opportunities may arise in the project.

Reference 3 - 0.38% Coverage

The client is also made aware of what probable outcomes of some changes.

Reference 4 - 0.74% Coverage

It is more important that there is a transparency between the team members and their line managers for the change to be evaluated properly.

Reference 5 - 0.62% Coverage

The quantity surveyor and scheduling manager could provide valuable information for the impact of change as well.

Reference 6 - 1.13% Coverage

Also, there is no set criteria for accepting or denying the change in the project. This makes the decision process dependent on the team's skill to evaluate the risks and benefits on a random way and take a decision

Reference 7 - 0.51% Coverage

The client could also be requested to share their experiences if the client is a private entity.

Reference 8 - 0.60% Coverage

Excel sheets are very common to understand cost related effects. Primavera is used to simulate the time effect.

Reference 9 - 0.93% Coverage

We are trying to use BIM for this now but facing a difficult time in using the software. We mostly need it for accurate evaluation of design changes and plans conflict reduction.

<u>Internals\\Preliminary Interviews\\P.I.Response #3 - § 5 references coded [3.91% Coverage]</u>

Reference 1 - 0.70% Coverage

Mostly the project director and the client evaluate changes that may affect the project progress.

Reference 2 - 0.74% Coverage

Also we may need design consultants for evaluating design changes due to coordination plans mistakes.

Reference 3 - 0.36% Coverage

Sometimes we share the cases together informally.

Reference 4 - 1.24% Coverage

some contracts may forbid the request for claims therefore the discussion will mostly be about the cost and time implications and how can losses of the contractor be reduced.

Reference 5 - 0.87% Coverage

None which causes problems in understanding the consequence of certain decisions and actions taken by the project team.

<u>Internals\\Preliminary Interviews\\P.I.Response #5 - § 10 references coded [8.55% Coverage]</u>

Reference 1 - 0.53% Coverage

Sometimes I share my experience as I manager the contracts of numerous projects simultaneously.

References 2 - 0.99% Coverage

Depending on the change, the most informed person should be involved in the process of evaluation. This could be the site engineer or the supervisor in the site.

Reference 3 - 1.34% Coverage

We try to involve every relevant person with experience too even if we ask the subcontractors or suppliers for their opinions. We have a contract with design consultants to provide us with their opinion about structural design changes when needed.

Reference 4 - 1.08% Coverage

We always try to use our experience in order to spread awareness that change is very common in this type of projects and specially design changes due to mistakes or conflicts between different systems.

Reference 5 - 0.73% Coverage

If it is a design change, this change is either referred to the client in-house design team or the consultant depending on the contract.

Reference 6 - 0.71% Coverage

The process of evaluation uses a limited amount of tools as we are
not aware of what else we could use practically to evaluate change.

Reference 7 - 0.76% Coverage

If the client requested a change, the change will be described
in a form that includes the justification and implementation method if needed.

Reference 8 - 0.98% Coverage

We are required to do root cause analysis if there is any change in the quality of work delivered. We also do risk assessments when it comes to using different methods of construction.

Reference 9 - 1.05% Coverage

We have a form for root cause analysis that works as a reporting tool filled in by the mostly informed person about the situation and eventually handed in to upper management for review and action.

Reference 10 - 0.40% Coverage

BIM would be also good for evaluating the cost, time and risks of the change.

The topics mentioned in the previous statements includes shared experiences between the project team, contract requirements, documentation requirements, evaluating changes to BOQ, evaluating design changes, evaluating change influence on time, cost and quality, evaluation collaborative approaches, evaluation tools, risk analysis for evaluation, criteria for elective changes and limitations, process transparency, project team skills and knowledge in the evaluation process, client involvement and flexibility and the potential benefits of using Building Information Modelling (BIM) in evaluating cost, time and risk.

Based on the coded text, the name of this node/theme was denoted as change evaluation. This node is described as ‘change evaluation practices, problems and potential improvements’ to discover the influence of changes on the different aspects of the project including cost, time, quality and risk.

The answers of Q3, Q8, Q13 of different interviews were analysed and coded under this node. The reason behind analysing these particular questions is that they were built to identify the current practices and tools used in change evaluation (Q3), problems encountered in change evaluation (Q8) and exploring potential room for improvement (Q13). Therefore this code included four underlying codes as well which are namely practices, tools, issues and suggested improvements. The answers of the interviewees were grouped and analysed for each question under the particular node.

After reviewing the four developed nodes, the author gained a better insight about the scope of change evaluation practices, tools, issues and potential improvements for the change evaluation process used by contractors in Kuwait.

The current practices of change evaluation includes recognising the influence of the change on different aspects of the project. The first aspect is looking into the effect of change on the Bill of Quantities (BOQ). This evaluation is frequently used when the change could involve change of material and process of construction. The effect on the contractor’s resources is also considered within the cost aspect. Another aspect is looking into the effect of the change on the project schedule and duration. Also, the effect of change on the project quality is also evaluated to prevent any deprivation of the delivered value for the client.

Understanding the effect of change on these various aspects would inform the decision of either approving the change or at least being prepared to deal with the change influences on the project progress and act accordingly.

The individuals involved in the evaluation process may vary based on different situations. This may mean the involvement of suppliers and subcontractors to gain better insight as to what constitutes the effects of the change on the project. Transparency may be highly necessary for gaining a better insight in the evaluation. The assistance of design consultants for evaluating design changes due to coordination plans mistakes may be necessary. The assistance of the risk manager, quality manager, contract manager, quantity surveyor could be used if required.

The involvement of the client is also essential to communicate how the change may influence the perceived value of the project. Since some changes may not influence the project parameters, the contractor is not obligated to communicate with the client about day to day changes in the process if the work is provided correctly without any depreciation of the delivery value.

When it comes to using tools, change evaluation usually entails the that the contractor uses spreadsheets to evaluate the influences of change according to the interviewees. Some contractors use a form for root cause analysis for investigating the main causes of the change and gain a better perspective about the actions needed. The results of the root cause analysis is eventually handed in to upper management for review and action.

The most popular tool used in evaluating change is Microsoft Excel according to the interviewees. Excel is used to note down data that represents the influence of the change on cost and on time in a table. This table is used later on in a report of evaluation. Additionally, scheduling softwares are used to simulate the effects of change on other tasks and on the duration of the project when applicable. These softwares are either Microsoft Project or Primavera. The critical path method is used in these softwares to determine the degree of influence from change on the project duration.

Several important issues were pointed out concerning the current change evaluation practices. These problems include incorrect cost and time evaluation of potential change, insufficient evaluation criteria, insufficient risk analysis for change outcome, insufficient use of tools and technology, insufficient communication and lack of transparency in the process. Similar analysis was done to conclude the other practices for contractors, their associated problems and potential improvements.

The lack of adequate documentation was also criticised by two interviewees. This improper documentation would result in a weak process of evaluation and lack of the element of learning by previous experiences within the project and the contracting company.

Another gap is the evaluation criteria and the evaluation process itself. The interviewees that the evaluation process lacks the insight about the change influence on the project. This would result in bearing any significant influences and risks by the contractor later on. The problem of the change evaluation criteria used is that it lacks rigour and does not properly do its job. Therefore, the weight of taking the proper decision is highly dependent on the project teams' knowledge and experience rather than previous data and predetermined metrics and estimations. One interviewee confirmed that the lack of proper tool usage in the change evaluation process is one of the biggest limits of the process success itself.

The following sections will illustrate the scope of project change management as applied by contractors in Kuwait from the perspectives of the interviewees. The section start with defining then exploring the different aspects of change management then highlight the level of standardisation of change management of contractors in Kuwait.

It will also include quotations from interviewees as evidence to support the discussion directly with the transcripts repressing the respondents perspectives. The preliminary interviewees will be referred to as "P.I." in this section in addition to showing the code of the respondent according to the previously shown background numbers.

6.2.5 Promote a balanced change culture

These practices are related to preparing the project team to manage change effectively and efficiently throughout the duration of the project.

Preparing the project team for managing change could be the responsibility of either the project manager or the upper management. Change preparedness is not exclusive for the employees of the contractors. It could also focus on increasing the awareness of the client about the potential effects of changes that are implemented in the construction phase. Therefore, change preparedness could be increased for the entire project team. The project team is mainly made aware of what potential positive or negative changes may be encountered in the project. Successful experiences from previous projects are shared between the project team members to raise awareness. P.I.#2 states “The project team is also made aware of what possible negative changes may be encountered and how opportunities may arise in the project”. This is done through exchange of information through either meetings at the beginning of the project or informal settings as mentioned by P.I.#2.

“We discuss this with newcomers to make sure that they do not do the same mistakes as we could” P.I.#1 mentioned. High communication and asking questions about encountered changes is endorsed throughout the project to make sure that the project team members are well equipped and fully understands the change in hand. This is specially a point of focus when newcomers with limited experience join the project and would be supported by their line managers when needed.

Value management is often used to make sure that maximum value is delivered in the project and limit any changes related to the client needs to arise later on in the project. This is represented by the contractor proposing better options at the outset of the project and allowing the client to see how these options could influence their business as pointed out by P.I.#1.

Prior to signing the contract, the contractor and the client usually share experiences in order for the contractor to have a better perception of what possible changes may be faced and reviewing the feasibility of the projects. P.I.#4 confirms that the project team tries to prevent changes as much as possible in the beginning of the project by checking all the contract requirements and project specifications and making sure that everything the project needs is on site. It is also critical to review the clauses related to change and whether changes to the project parameters is permitted or not in the contract. Reviewing the claim process should also be a main point of focus.

This is exclusively done in private projects as it was raised by P.I.#3 (and previewed by the literature review section) that this is not always an option for public projects in Kuwait. P.I.#1 mentioned that as a project manager, he would review the contract documents and try to understand how change is managed according to the contract clauses. Changes to the contract would later on be referred to the contract manager for advisement and insight about the teams ability to integrate the change and whether this change would be reimbursed by the client or not.

The interviewees agree that informal discussions are mainly used to spread awareness. There are no formal initiatives done by contractors to promote change preparedness of the project team is extremely limited. “The knowledge is shared casually through the project managers with their teams” as mentioned by P.I.#4. The problem with that valuable information is lost between this rather ineffective method of transferring knowledge about change. Which would in turn make the project team members do unnecessary mistakes which could be avoided from learning from previous experiences in similar projects. In other words, the lack of process would cause a general lack of change readiness of the project team.

It was also pointed out that there is no dedicated funds for relevant training while priority is given to other trainings if needed such as occupational health and safety training. Some interviewees recommended the utilisation of corporate training, in-house training, online courses to improve the knowledge and skills of the team. P.I.#1 confirms that”no dedicated funds for training is given for change management”. P.I.#2 adds that“learning along the way” is the generally used approach to spread awareness rather than proper training of project team member. P.I.#3 similarly mentioned that “ the team members learn as they go through cases in the project” which could cause problems that could have been avoided if the team properly understood some aspects of the project works.

Dominantly, the interviewees agreed that there are no particular tools used by contractors to promote a balanced change culture. Tools such as the smartphones, emails are generally used for exchanging information between team members. Contractors usually use emails to spread awareness about change management. In limited cases, contractors use change logs from previous projects to spread awareness amongst the project team. Nonetheless and due to confidentiality reasons, change logs may be not shared within the contracting company. Nonetheless, P.I.#5 proposed that a list of previous changes could be presented to all the project team by excluding any prices thus preserving the confidentiality of these changes. P.I.#3 affirms that such a list would be fantastic to learn from and specially for newcomers.

6.2.6 Identify change

These practices related to acknowledge changes arising in the project and the ability to describe these change.

The phase of identifying change involves various stakeholders within the contracting company according to the interviewees such as the project manager, scheduling engineer, quality manager, design team, site engineer, section engineer and even the owner of the company in some cases. The interviewees agree that the change should be described by the person who is mostly informed about it no matter what the position is. This is why some interviewees pointed out that the site workers and supervisors are also involved in identifying the site related changes. Some changes are identified when they arise in the project.

The formal process for the identification of all project changes is very limited as mentioned by the interviewees. It is simply done when faced with a change then communicating it with the line manager who will either take action or pass it on to the next line manager as stated by P.I.#1. If needed, a change request maybe drafted and sent to the client. "The client may also be involved in the case of change proposals or sample preview if the project team finds better solutions or materials" as mentioned by P.I.#4. Sometimes, if the change is very minor and would not affect the progress of work in anyway and would not contradict with any contract requirements, the change is identified and a decision is made on how to deal with it on the spot.

P.I.#5 interviewee pointed out that as per some contracts, the change should be identified within a particular time of this change occurring. That is assuming that this change will cause a basis for variation or submitting a claim by the contractor P.I.#5 adds. It is important to note that not all contracts allow variation while others may allow claims based on changes in material prices, problems with workers permits causing delays, delivery issues outside the hand of the contractor or even due the restricted hours of working due to the summer conditions.

On the other hand, contracting companies review the changes to cost and time on a quarterly basis by comparing the planned progress with the actual achievements of the project. This is usually a process that is monitored by the project manager. P.I.#5 confirms that any changes are immediately communicated with the client through a memo and a formal meeting explaining the root causes of the deviations and the action plan to find the most suitable solution.

Change is identified and communicated through both formal and informal routes. Formal includes emails, reports and memos being used to describe this change while informal can include using smart phones, group messaging or face to face conversations. The interviewees agree that Microsoft word and excel is commonly used in describing the change and is considered sufficient for basic descriptions.

These forms of communication may include the attachment of photos or videos in the case of site changes. P.I.#4 says that management request photos for reporting or even videos if needed. As an example an error in the installation of machinery may cause a change to the duration of the project. Such attachments are compulsory when it comes to communicating change with the client. Communication can be improved through the usage of a content management system that would represent a platform for fast communication and also include whatever documentation is necessary in the process as suggested by an interviewee.

P.I.#1 pointed out that investments in training related to increasing the project teams ability to identify change are very limited. The training mostly involve project management skills and knowledge and is exclusively delivered to middle and upper management. This is an actual problem since the entire team should be able to identify change not only the middle and upper management as mentioned by P.I.#3. Awareness emails are rarely sent and also remains unread by the email receivers.

The interviewees agreed that the concept of change prediction is not really used in the construction industry of Kuwait. Nonetheless, its integration may be very beneficial to anticipate what changes my occur in the project and increase the preparedness of the project team as stressed by P.I.#1. Another interviewee thought that change predication is also useful as database to identify potential changes.

Another potential improvement to the current practices and is on the rise in Kuwait is Building Information Modelling (BIM). P.I.#5 mentioned that the ministry of public works in Kuwait is currently using BIM for 5 pilot projects in order to understand what benefits may be possible with this revolutionary approach. This integration will be very useful for identifying changes and limiting mistakes in the project as pointed out by three interviewees.

6.2.7 Evaluate Change

These practices related to evaluating project changes and its possible influence on the range of parameters in the project.

The evaluation process typically involves a big range of stakeholders including the contracting company, owner, consultant, subcontractors and suppliers. This big range of involvement is related to the trying to anticipate the implications of integrating the change in the project and understand the feasibility of the change integration accordingly. The implications of the change on the cost, time, quality, risk and quality is thoroughly investigated before implementing the change in the project. Design change are often refereed to design consultants to provide their insight as well. This is very popular when it comes to changes in the structural system in the project. “We need design consultants for evaluating design changes due to coordination plans mistakes” as mentioned by P.I.#3.

The interviewees stressed on the need to involve whichever stakeholder who can provide the project team with a better insight about the outcome of the change integration. This is a practice that usually followed by contractors in Kuwait as pointed out by P.I.#2 & P.I.#5. An important factor to assure this practice is done properly is to ensure that there is high transparency between project stakeholders for the change to be evaluated properly. This may apply to the communication between the employees of the contracting company and their line managers or between different stakeholders such as the subcontractor and the contractor. P.I.#2 confirmed by stating that it is essential that there is a transparency between the team members and their line managers for the change to be evaluated properly.

Interviewees assure that the minor change may not influence the project parameters are solved in the site and on the spot rather than being communicated with the client. Major changes which may influence the project parameters is referred to the client for written approval prior to implementation. The evaluation is passed to upper management if a variation to the contract partners is needed and/or a claim is needed. Upper management would in turn send the evaluation outcome to the client in the form an official memo as pointed out by P.I.#5.

In some contracts which may forbid the request for claims by the contractor, the discussion will be amongst the contractors project team mostly be about the cost and time implications and how can losses of the contractor be reduced as mentioned by P.I.#3. The outcome of this discussion is communicated with the client even though there will not be any cost reimbursements by the client.

Tools used for the change evaluation is very similar and very limited amongst contracts in Kuwait according to the interviewees. Most Microsoft excel is used when the change's influence on the project cost is investigated as mentioned by P.I.#3. Root cause analysis is used to understand the main reasons of the changes in the quality of work delivered and decide accordingly on the proper action required. Some contractors use a standardised form for root cause analysis to make sure that the proper steps are done. For instance, the "five why's" method is properly described in the form for proper usage by the user. Risk analysis is also used but not at an advanced level to understand what could possibly occur due to integrating the change as mentioned by P.I.#5. Primavera is used to simulate the time effect of the change on the project schedule and duration.

Even though the practices of project change evaluation is very similar according to different interviewees, but some criticism of the process was pointed out. The biggest limitation of the current process is the lack of evaluation basis and evaluation criteria for the project change. There is no database or spreadsheet built form previous project to indicate the implications of the previously encountered changes. There is also no particular criteria for accepting or denying the change in the project. This makes the decision process dependent on the team's skill and experience to evaluate the risks and benefits on a random way and take a decision. P.I.#2 recommended the usage of BIM for accurate evaluation of design changes and the reduction of conflict. BIM would be also good for evaluating the cost, time and risks of the changes according to P.I.#5.

6.2.8 Implement Change

These practices related to integrating the approved changes in the project and monitor the progress and outcome of this integration.

Depending on the change, different individuals would be accountable for the implementation, monitoring of the implementation progress and outcome of integration. For site rated changes, the site engineer and section engineer are frequently referred to as the individuals responsible for implementing the change. There is also a scheduling engineer that could be involved in implementing and tracking schedule changes according to P.I.#4. The quantity surveyor would constantly check the progress against the estimated costs to realise any deviations. The team of designers would be responsible for design changes.

The project change implementation monitoring is usually done by the project manager. In case the project faces an unexpected change, it is also common practice for the project manager to be responsible for creating and monitoring an action plan of the change implementation. Risk monitoring is done to see the development of the change integration in site works.

The monitoring is usually either informal or formal depending on the impact of the change. Informal reporting include phone calls, messages and face to face conversations. Formal reporting represented frequently in the form of a day to day reporting or over a longer period such as monthly or quarterly reports according to P.I.#2 and P.I.#4. This report is either submitted as a hard copy or via emails to the project manager. The consistent and clear reporting is endorsed in some contracting companies through connecting improper reporting with issuing HR warning letters. Formal reporting is compulsory when the change is required to be monitored by the client. Therefore the project team would present this report to the client through a particular template as requested by the client. This reporting is typically on a monthly basis. Formal reporting is usually done using Microsoft word or Microsoft excel as pointed out by the interviewees.

Change logs are commonly used to reflect the status of the change integration according to P.I.#4. The interviewees agreed that this sheet is theoretically good but does to necessarily reflect wha tis actually happening in reality. This may be due to the lack of consistent updates by the responsible individuals. It was suggested that this change log should be controlled in a better way by a person dedicated for this matter.

P.I.#3 suggested that a proper communication method such as a content management system is needed for live and updated reporting. This system therefore should be accessible on the project teams smartphone for simple and fast usage in addition to having a clear update about the status of the change implementation. It was also suggested by

P.I.#5 that BIM would be excellent for creating easy and updated communication between all stakeholders to monitor and report on the change status.

6.2.9 Continuous Improvement

These practices related to learning from previous lessons of managing project change and improving future performances.

The main pattern between contractors when it comes to practices related to the continuous improvement in the project is that the project team learns by experience along the process of the project according to P.I.#1 & P.I.#4.

Learning from previous lessons frequently comes in the form of informal conversations between the project team members. The main aim of these conversations is to avoid the mistakes that were done in previous and similar projects as mentioned by P.I#3.

Similarly an official kick-off meeting (or lunch) can be done with the same purpose as pointed out by P.I.#1. The entire project team working for the contractor would be invited to learn and share their successful stories as well.

In the case of private projects, the client would also be involved in these discussions. On the other hand, all the interviewees agreed that public clients in Kuwait do not care about improvement and are not receptive to any notes to improve planning or designs for similar projects. In other words, the problem with the design causing change will be faced by every contractor dealing with this typical project.

P.I.#1 and P.I.#4 pointed out that this arbitrary way of learning from previous lessons is inadequate and causes the contracting company to do mistakes and redo it later on as well. One interviewee gave an example of differing site conditions that would cause problems every single project and pointed out that no measure is done to take precautions against this point. The interviewees agreed that this process should be documented and shared amongst the project team and across different project teams within the contracting company as well for increased improvement and awareness. The lack of documentation was justified by one interviewees through stating that the project team is being challenged at every stage of the project with many problems and no one has the time to putt the effort to document the mistakes we did and prevent it in the future. Another interviewee similarly pointed out that continuous improvement is luxury that cannot be afforded in the environment of mistakes and major incompetence.

Formal experiences changes is rarely done through sharing the change logs from previous projects according to P.I.#3. This option is less likely since information on these change logs is frequently considered confidential and is not shared amount the entire team to preserve the privacy of the change transactions of previous projects. Emails are also sometimes used to spread knowledge about preview experiences.

Creating a database and using it as a future reference would be good for improvement as endorsed by P.I.#1, P.I.#3 and P.I.#5. This database should include records of the previously done mistakes that caused changes or client requirements and their descriptions. One interviewee pointed out that this approach would be fantastic for newcomers with limited experience.

6.2.10 Organisational Standardisation

Organisational standardisation is the degree of change management process Institutionalisation across different projects within the contracting company.

In general, the standardisation of the change management process amongst the projects handled by the same contractor is very limited. The interviewees agree that there is no policy for managing change. The main emphasis of the policy is either focused on safety, quality or the sustainability. Other policies focuses on the need to deliver value to the client according to the cost, time and quality but does not mention change management.

P.I.#2 referred to the Project Management Book of Knowledge (PMBOK) for controlling change within the interviewees contracting company. The PMBOK is made available for middle and upper management as a soft copy reference. The interviewee who is working for this contracting company said that the PMBOK is a good start but is limited when it comes to the whole cycle of managing change in the project. The policy in this company mentions that the project team should be able to use the most practicable project management solutions and refers to the PMBOK.

P.I.#4 justified the general absence of change management standardisation by rarely encountering change in their small projects since they are focused on very short duration finishing projects only where changes are not usually permitted. One interviewee pointed out that the possible reason is that each project has to manage change according to the contract itself rather than an organisational policy. Nonetheless, it is common the project managers communicate with each other to understand the best practices of change management when contract clauses in different projects are the same according to P.I.#5. It is safe to say that there is no standardisation of change management practices amongst projects handled by contractors in Kuwait. This lack of standardisation causes unreliable outputs of the change management process of contractors.

6.2.11 Process trends and mutual patterns

Looking at the preliminary interviews results, some trends and mutual patterns could be recognised about the overall scope of change management and across its different stages. These trends can be viewed as implicit behaviour or actions behind the change management processes as utilised by contractors in Kuwait.

First, there is a low inclination to using any advanced technology, programs or algorithm to manage change. Other basic tools are generally used in order to manage changes including Microsoft Word, Excel and Project. Such preference may be due to different factors such as lack of awareness or lack of interest in the usage of unknown methods and tools to manage change while simpler methods and tools could be used.

The overall process of learning and gaining experience relevant to the change management stages is clearly done on a random basis. The interviewees indicated that learning on the job site and gaining experience by doing mistakes is the primary way of learning in their organisations. This would indicate the lack of training and preparation the team members would receive prior to conducting change related processes. The exchange of knowledge is generally done on a random basis rather than certain points or a stage of the project. Informally exchanging experiences and knowledge was very common in the perspectives of the interviewees in comparison with formal training sessions, induction sessions or courses concerning change management.

Proper and timely communication is vital to properly manage change and control the outcome accordingly. It is widely perceived by the interviewees that frequent communication and feedback is dependent on several factors including the client type (public or private entity), type of project and the degree of innovation involved in different project stages, scale of the project.

It is also clear that the contract type and viability of variation clause would dictate how change management is conducted and the degree of documentation required to complete the process.

Finally, the overall standardisation of change management processes is not common amongst the different stages even though numerous interviewees indicated that their organisations use standard processes and procedures for other project management disciplines such as quality management, safety management, cost management… etc. Even though theoretically these disciplines should include change integration (PMI, 2003), the interviewees indicated that managing changes would not be carried on as systematic as it should be. Some interviewees thought standardisation is not necessary and is dependent on the type or size of the project. Generally, change is managed on an ad-hoc basis which does not facilitate change management performance measurement, benchmarking and improvement within the organisation. The non-standard process used causes a lack of transparency which is desired by some contractors who are willing to take advantage of change requests to make additional profits as pointed out by one of the interviewees.

The output of the preliminary interviews analysis was be used to create a comprehensive list of change management practices based on the previous literate review and the results of the preliminary interviews. The huge advantage of creating this comprehensive list is that the input of the preliminary interviews represents a valuable addition to the previously conducted literature review and increases the research's degree of relevance to the Kuwaiti construction industry. This list is needed in the questionnaire survey which was used as a consequent research method within this study.

To make sure that the compiled list is comprehensive and built systematically, the practices and tools extracted from both the literature and preliminary interviews were organised according to the change management stages. These stages are also aligned with the codes used in the thematic analysis of the interview transcripts as previously discussed. Table 6-11 shows the comprehensive list of change management practices and tools extracted from the literature and preliminary interviews. The practices extracted from the preliminary interviews includes both the current practices and the suggested improvements of the change management process based on the limitations and issues faced by contractors in Kuwait.

Table 6-11 Comprehensive list of change management practices and tools

Change Management Stage	**Practices & Tools**
Promote a balanced change culture	Change management roles assignment to project team
	Change management committee
	Active and visible management sponsorship
	Dedicated change management training, resources and funding
	Engagement with and support from middle management
	Reviewing the feasibility of the project requirements prior to signing the contract
	Review contract clauses related to variation
	Using awareness emails about positive and negative changes
	Share knowledge and experience through informal discussions
	Share knowledge and experience through change logs of previous projects
	Share knowledge and experience through a shared database
	Share knowledge and experience through formal meetings
	New staff induction and preparation for the change process
	Encouraging transparency and communication amongst team members
	Using online courses to increase project team's knowledge and skills
	Using change management related books
	Change readiness audit
	Use standard forms and documentation in promoting a balanced change culture
Identify change	Compare actual cost with the BOQ
	Compare actual quantities with the BOQ
	Compare actual quality with the contract requirements and specification
	Compare actual project progress with the project schedule
	Using Microsoft word for describing the change cause(s)
	Using Microsoft excel for describing the change cause(s)
	Create a written report how the change occurred and describe it clearly

	Communicate orallywhen a change occurs
	Communicate through email when a change occurs
	Use photos for reporting site work related changes
	Use videos for reporting site work related changes
	Use value management to identify positive changes
	Communicate with the client when the change will affect the project progress or parameters
	Use change prediction tools
	Use a database to identify potential change(s)
	Use root cause analysis to understand main trigger(s) of the change
	Use Building Information Modelling (BIM) for change identification
	Use standard forms and documentation in identifying change
Evaluate change	Trend program
	Web-based application for managing change orders in construction projects
	System dynamics
	Functional analysis concept design
	Project change triangle tool
	Use risk analysis to understand change implications
	Change prediction system using activity-based dependency structure matrix (DSM)
	Change log
	Building Information Modelling (BIM)
	Productivity oriented analysis of design revisions
	Records management
	Knowledge-based decision support system (KBDSS)
	Earned value methods
	IT-based change management system (CMS)
	Request the expertise of the subcontractor if needed
	Request the expertise of suppliers if needed
	Request the expertise of design consultants to evaluate design changes
	Use Microsoft excel to evaluate quantity changes
	Use Microsoft excel to evaluate cost changes
	Use scheduling softwares to evaluate time changes

	Formal reporting of evaluation outcome to clients Use root cause analysis to provide a better evaluation insight Use standard forms and documentation in evaluating change
Implement change	Monitor implemented change and report on a daily, weekly or monthly basis on the situation Using phones, messages and group messaging to provide updates about the change Using emails to provide updates about the change Use Microsoft excel to monitor change Use Microsoft word to monitor change Gain formal approval from the client prior to change implementation Implement minor changes that would not affect project parameters and requirements without client approval Using a change log Update the change led on a daily basis Using a Content Management System (CMS) for communication Use Building Information Modelling (BIM) for change tracking Use standard forms and documentation in implementing and monitoring change
Continous improvement	Benchmarking processes outcomes Using a Content Management System (CMS) for storing knowledge and lessons learned Informal discussion to share experiences Using a chatting group to share experiences Closeout meeting at the end of the project to share experiences Using content management system Use, update and maintain change logs Encourage professional development in change management Encourage self-driven knowledge and skill development Use standard forms and documentation in continuously improving from lesson learned

Essentially, all the practices and tools extracted from the literature and the preliminary interviews were verified for relevance and applicability by contractors in Kuwait. This verification was done in the next stage of the research by using a questionnaire survey that employs the perspectives of a big sample of contractors in Kuwait. This has determined the essential change management practices and tools that are already used or could potentially and practically be used by contractors in Kuwait.

6.3 QUESTIONNAIRE SURVEY

After analysing the results of the preliminary interviews, a questionnaire survey is used with the main objective of collecting data from contractors to create a full picture of the change management aspects in Kuwait. These aspects include the practices and tools used to promote a balanced change culture, identify change, evaluate change, implement change and continuous improvement. Additionally, other aspects including contract type, variation clause utilisation, involved stakeholder and problems faced within the change management process was investigated to provide a deeper insight into change management process used by contractors.

The previously created list of change management practices and tools extracted from the preliminary interviews and literature review was reviewed and verified by contractors on a wider scale. This verification is based on the frequency through which each practice and tool is used in the project to manage change from the perspectives of the respondents. The verified change management practices and tools were later on be grouped under Key Process Areas (KPA's) and used the developed model as improvement criteria.

6.3.1 Questionnaire design

The questionnaire design includes the selection of the sample, sampling technique, pilot survey questions and full survey questions (Oppenheim, 2000). The questionnaire design is considered to be completed when the survey questions are verified and finalised by having the input of the respondents of the pilot surveys and being prepared to be sent out to the full survey respondents (Oppenheim, 2000).

Selecting a representative sample from a bigger population is essential to draw proper and generalisable conclusions (Jupp, 2006). The selected sampling frame used is presented by Kuwait's Central Tenders Committee (CTC) website which includes a list of contracting companies in Kuwait. This list covers the range of contractors categories from one to four. The total number of contracting companies according to the list presented by CTC is 496 companies. The individual professionals were considered as the subjects of this research rather than contracting companies. This choice will contribute to increasing the accuracy of the data collection process. The random sampling technique was used to randomly select the questionnaire participants from the selected sampling frame.

The questions used in the survey should facilitate the verification of the change management practices and tools which were compiled from the literature review and the preliminary interviews. The questions also should enable the respondents to expand the list if it is possible. This ensured that the developed model using the final and verified list of change management practices and tools is as suitable as it could be for the utilisation by contractors in Kuwait. The literature review and preliminary interview results were used in the inception of the survey questions. The themes discovered in the preliminary interviews were systematically investigated throughout the questions. First, the questions should verify the applicability of the comprehensive list of practices and tools complied from both the literature review and the preliminary interviews.

Exploring these practices and tools was done in alignment with the change management stages to allow for a systematic verification and expansion if possible. Also, the questions attempt to identify the stakeholders that are involved in each change management stage. The list of stakeholders employed within the contracting company and external to the contracting company was created by analysing the preliminary interviews transcripts and compiling all the possible stakeholders relevant to change management in the Kuwaiti construction industry. Additionally, questions should also look into the level of standardisation of change management. Understanding if change is managed in an institutionalised approach or project by project basis would provide the author with a better perspective of which processes are standardised and which are not. Determining how “standardisation” is perceived by contractors in Kuwait would be a valuable to the creation of the model in the subsequent stages.

The questionnaire included fourteen questions were created and distributed over eight parts as shown in Appendix E. The first part focused on the demographics of the survey participants, the type of projects they are usually involved in and the contract types they usually use in these projects. The next five parts represents the essence of the survey and focused on the five stages of change management and the frequency of using the practices and tools extracted from the literature review and the preliminary interviews.

These parts are particularly important because it facilitated a better understanding of the frequency of change management practices utilisation by contractors in Kuwait on a wider scale. The questionnaire also investigated the frequency of using an organisational standard documents and procedures in managing the project change in the sixth part which is particularly important to understand the level of standardisation amongst contracting companies in Kuwait when integrating the process of change management across their spectrum of different projects. The seventh part focused on exploring the frequency of the internal stakeholders (employed within the contracting company) and external stakeholders (not employed within the contracting company) involvement in the change process to understand the current roles played by different stakeholders within the change management process. Finally, The eighth part would seek the respondents' views on the issues that are faced throughout the process of change management in order to enhance the overall suitability and adequacy of the currently used change management practices and tools.

The questions allowed the respondent to answer through a five-point Likert scale of either frequency (1 = always, 2 = very often, 3 = sometimes, 4 = rarely, 5 = never) or agreement (1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree and 5 = strongly disagree). The answers of these questions are considered ordinal variables since they can be arranged in an ascending or descending order but do not include a clear and exact range. This type of variables is more accurate than the typical dichotomous questions through illustrating the degree of frequency or agreement of the respondents rather than a yes or no answer.

6.3.2 Data Collection

Prior to sending out the survey to the entire sample of contractors in Kuwait, a pilot study was undertaken through distributing the survey to seven project managers. The main purpose of the pilot study was to test the survey instrument and make sure that the questions were clear and would not be interpreted incorrectly or differently by the respondents. To assure that this process was done correctly, the author handed in the survey to the pilot study participants and attempted to understand the overall challenges they faced when filling the responses. For this stage, the survey was filled out electronically rather than using hard copies by the participants. The survey was uploaded manually to a computer later on. After answering the survey questions, the following questions were asked about the survey instrument itself:

•Do you think that the survey instructions are clear and straightforward?

•Do you think that the survey is too long?

•Do you find any questions to be unclear?

•Do you have any suggestions regarding the addition or removal of questions?

•Do you think that the survey format and/or sections arrangement needs improvement?

Based on the responses of the pilot study, the feedback is considered positive. All of the respondents said that the instructions and questions were clear, well formatted and properly arranged. Since there were no comments necessitating any required modifications, the survey remained unchanged. The responses collected from the pilot study participants were used in the data analysis later on as they were extracted using a valid survey instrument.

Following the results of the pilot study, the full survey was conducted. The sampling frame used in this study is provided by Kuwait's Central Tenders Committee (CTC) website which shows a comprehensive list of the local contracting companies. This list includes contractors classified against different categories ranging from category I, II, III and IV through which a representative sample is drawn from. Jarkas & Bitar (2012) used the random sampling technique identify and rank the relative importance of factors that influence labour productivity in Kuwait.

The random sampling technique ensured that all the samples have an equal chance to be selected and studied (Jarkas & Bitar, 2012) which would allow for properly representative results. Since their research was conducted in Kuwait and has a similar target population as this study (contractors in Kuwait), the random sampling technique was also utilised in this research. This allowed the researcher to extract valuable data from contractors classified in categories I, II, III and IV and draw the full picture of change management utilisation in Kuwait rather than focusing on specific organisations that would be less representative of the wider population.

Accordingly, the survey was distributed to 112 participants who are employed in contracting companies located in Kuwait. These participants are currently employed in positions that would allow them to be part of the change management process such as project directors, projects managers, construction managers and other roles that was mentioned in the respondents demographics section. This ensures that the input of the participants and knowledge of the change management practices and tools used in the contracting companies is recent and representative to realistic application of change management.

The author collected data through passing by the projects in person and handing in a tablet through which the participants would enter their responses electronically. To save time and collect responses simultaneously, a hard copy of the survey was also distributed to the participants and entered later on manually by the author to create an electronic version of the responses. Even though this approach required more effort and time in collecting the data, the approach proved its effectiveness through achieving a resulting response rate of 100%.

6.3.3 Analysis of Questionnaire Results

Following the data collection, the data was analysed using the SPSS 24 statistics software. To enable the analysis, a numeric value and codes were denoted to all the variables as shown in Appendix F.

6.3.4 Respondents Demographics Statistics

The demographics of the participants were investigated in the first part of the survey. The demographics covered the position, years of experience, type of projects involved in and the category of the contracting company in the Central Tenders Committee of Kuwait (CTC).

The positions of the participants in their organisations are shown in Table 6-12. Participants in other roles included site engineers, section engineers, office engineer, planning engineers, planning managers, quantity surveys, procurement engineer, logistics manager, contract administrator, quality managers and quality control engineers. It was assumed that covering more positions within the contracting company would eventually provide the author with a better and wider perspective about the nature and effectiveness of the change management process within these contracting companies. Nonetheless, the emphasis on collecting the responses from respondents with management position was clear since their knowledge of the change management process would highly contribute to this survey.

Table 6-13 shows the number of years of experience of the respondents. The respondents ranged from having less than 5 years of experience to more than 25 years of experience. The majority of the respondents have extensive experience and can provide reliable views as to what constitutes the process of managing change throughout the different stages.

Table 6-14 shows the category of the contracting company that the respondent is employed in or own. The categorisation is done as per the Central Tenders Committee (CTC) of Kuwait. The survey respondents covered the four categories of contractors. The split of samples was done according to several factors. The first being that contracting companies within the first two categories co-operated more in filling the survey. The second being that the likeliness usage of the capability maturity model later would be more useful for larger organisation (categories I and II) rather than smaller organisation therefore emphasis should be given to the first two categories. Nonetheless, the coverage of the four categories is necessary to ensure that the data collected about the change management practices and tools considers the different sizes and experiences of the contracting companies of Kuwait.

Table 6-15 shows the types of projects the contracting companies are involved in. The types of projects included residential, commercial, infrastructure, roads, drainage, industrial in addition to oil and gas projects.

Table 6-12 Survey participants demographics

What is your role in the contracting company?		
Responses	**Response Percent**	**Number of Responses**
Director/Senior Manager	5.40%	6
Contracts Manager	14.30%	16
Project Manager	42.00%	47
Construction Manager	17.90%	20
Other Roles (please specify):	20.50%	23

Table 6-13 Survey participants experience

How many years of experience do you have in the construction industry?		
Responses	**Response Percent**	**Number of Responses**
0-5 Years	4.46%	5
6-10 Years	7.14%	8
11-15 Years	22.32%	25
16-20 Years	18.75%	21
21-25 Years	30.36%	34
More than 25 Years	16.96%	19

Table 6-14 The categories of the contracting companies

What is the category of the contracting company you are working for?		
Responses	**Response Percent**	**Number of Responses**
Category I	42.00%	47
Category II	34.80%	39
Category III	17.90%	20
Category IV	5.40%	6

Table 6-15 The types of projects done by the contracting company

What are the types of projects is your company involved in? (multiple answers may be chosen)		
Responses	**Response Percent**	**Number of Responses**
Residential Projects	23.24%	76
Commercial Projects	21.41%	70
Infrastructures, Road and Drainage Projects	22.02%	72
Industrial Projects	17.43%	57
Oil and Gas Constructions	15.90%	52

6.3.5 Contractual Statistics

The types of contracts used by the contracting companies and their frequency of usage were indicated by the respondents as shown in Table 6-16. The contracts used included lump-sum, remeasured and cost plus. The respondents were given the options to suggest other types of contracts used but no suggestions were provided.

Table 6-16 Responses on contract types used

Contract types	**Always (1)**	**Very often (2)**	**Sometimes (3)**	**Rarely (4)**	**Never (5)**
Lump sum contract	35	56	20	0	0
Remeasure contract	18	51	33	5	4
Cost plus	1	26	49	26	9

In order to comprehend the usage frequency of these contracts, it is necessary to use an analysis techniques which can deal with ordinal data. Calculating the mean is beneficial to compare the respondents' frequency rating on an ordinal scale (Jupp, 2006; Walkman, 2006) and eventually indicate the ranking of contract types usage. Then the frequency index (FI) would be calculated through dividing the mean value which needs to be calculated for each element over the maximum score of 5. Kaming *et al.* (1997) used this method to rank the time and cost overrun related responses that were taken on an ordinal measurement scale. Love & Smith (2003) also used the same approach in ranking the causes of reworks based on ordinal responses of clients. On this basis, the frequency index was used regularly throughout the data analysis of the survey results in order to determine the ranking of various elements.

Based on the numbering of the ordinal scale used in this survey, the lower the FI, the more frequent that contract would be used. Table 6-17 shows the rankings of the contract types usage by contractors through comparing their FI's. Apparently, the lump sum contract (0.372) was the most frequently used type of contract followed by the remeasure contract (0.466) and with the cost plus contract (0.628) being the least used type of contract amongst the three types.

Table 6-17 Ranking of contract types used

Contracts used	Mean	Frequency Index	Ranking
Lump Sum	1.86	0.37	1
Remeasure	2.33	0.47	2
Cost Plus	3.14	0.63	3

The survey also looked into the frequency of variation clause availability in the contracts as shown in Table 6-18. 52.25% of the respondents indicated that variation clauses are very often featured in the contract while 23.42% indicated that it is always available in the contract. 21.62% of the respondents chose that the contract sometimes could feature a variation clause. Meanwhile only two respondents indicated that the variation clause is rarely available in the contract while one respondent indicated that a variation clause is never used in a contract.

Table 6-18 Responses on variation clause availability

Variation clause availability	Response Percent	Number of responses
Always	23.21%	26
Very often	51.79%	58
Sometimes	22.32%	25
Rarely	1.79%	2
Never	0.89%	1

6.3.6 Change Management Tools and Practices

The means and frequency indices were calculated for each and every change management practice and tool that was featured in the survey. Knowing the frequency of using each of these practices and tools assisted in defining the currently implemented change management process. It is also important to understand that the frequent usage of practices and tools indicate that they deliver favourable outcome and is value adding to the change management process from the perspectives of contractors in Kuwait. This later on contributed to the model through ensuring that all the essential practices used in Kuwait are also included in the model.

Table 6-19 shows the rankings of the practices and tools used in promoting a balanced change culture . Clearly, ‘review the feasibility of the project requirements and variation clauses prior to signing the contract’ ranked the most important (0.542) followed by ‘encourage transparency and communication amongst team members’ (0.56), ‘share knowledge and experience through informal discussions’ (0.59), ‘share knowledge and experience through formal meetings’ (0.654). Sequentially, ‘circulate awareness emails’ (0.662) was indicated as a highly frequent practice followed by ‘share knowledge and experience through change logs of previous projects and/or shared databases’ (0.68) and ‘sponsor and support the culture of change’ (0.69). Finally, ‘dedicate change management training, resources and funding’ (0.71), ‘assign change management roles’ (0.734), ‘audit the team's preparedness for change’ (0.77) and ‘use standard forms and documentation in promoting a balanced change culture’ (0.846) were ranked last as the least frequently used practices.

Table 6-19 The ranking of change management practices and tools related to promoting a balanced change culture

Promoting a balanced change culture			
Practice/Tool	**Mean**	**Frequency Index**	**Ranking**
Review the feasibility of the project requirements and variation clauses prior to signing the contract	2.71	0.54	1
Encourage transparency and communication amongst team members	2.80	0.56	2
Share knowledge and experience through informal discussions	2.95	0.59	3
Share knowledge and experience through formal meetings	3.27	0.65	4
Circulate awareness emails	3.31	0.66	5
Share knowledge and experience through change logs of previous projects and/or shared databases	3.40	0.68	6
Sponsor and support the culture of change	3.45	0.69	7
Dedicate change management training, resources and funding	3.55	0.71	8
Assign change management roles	3.67	0.73	9

Audit the team's preparedness for change	3.85	0.77	10
Use standard forms and documentation in promoting a balanced change culture	4.23	0.85	11

Next, Table 6-20 shows the rankings of the practices and tools used to identify project changes were ranked. ‘Compare actual quality with the contract requirements and specification’ (0.3) was the first ranked practice used to identify change followed by ‘use Microsoft word and/or Microsoft Excel for describing the change cause(s)’ (0.306), compare actual project progress with the project schedule (0.308), ‘compare actual cost and quantities with the approved BOQ’ (0.312), ‘communicate when a change occurs (verbally and/or writing)’ (0.33), ‘use photos and/or videos for reporting the work site related changes’ (0.378), ‘use value management to identify positive changes’ (0.678), ‘use root cause analysis to understand main trigger(s) of the change’ (0.81), ‘use a database to identify potential change(s)’ (0.812), ‘use standard forms and documentation in identifying change’ (0.856), ‘use Building Information Modelling (BIM) for change identification’ (0.904) and finally ‘use change prediction tools’ had the lowest ranking amongst these practices and tools. The main reason behind the low ranking of change prediction tools may be the complexity of use and lack of awareness in the construction industry of Kuwait.

Table 6-20 The ranking of change management practices and tools related to identifying change

Identifying change			
Practice/Tool	**Mean**	**Frequency Index**	**Ranking**
Compare actual quality with the contract requirements and specification	1.50	0.30	1
Use Microsoft word and/or Microsoft Excel for describing the change cause(s)	1.53	0.31	2
Compare actual project progress with the project schedule	1.54	0.31	3
Compare actual cost and quantities with the approved BOQ	1.56	0.31	4
Communicate when a change occurs (verbally and/or writing)	1.65	0.33	5
Use photos and/or videos for reporting the work site related changes	1.89	0.38	6
Use value management to identify positive changes	3.39	0.68	7
Use root cause analysis to understand main trigger(s) of the change	4.05	0.81	8
Use a database to identify potential change(s)	4.06	0.81	9

Use standard forms and documentation in identifying change	4.28	0.86	10
Use Building Information Modelling (BIM) for change identification	4.52	0.90	11
Use change prediction tools	4.60	0.92	12

Next, Table 6-21 shows the rankings of the practices and tools used to evaluate project changes. When it comes to evaluating change, ‘use Microsoft excel to evaluate quantity and/or cost changes’ (0.434) ranked first for frequency of use followed by ‘use scheduling softwares to evaluate schedule related changes’(0.444), ‘request the expertise of the subcontractor, suppliers or the design consultants if needed’ (0.558), ’use root cause analysis’, ‘use a change log’ (0.672), ‘use records management’ (0.764), ‘use standard forms and documentation in evaluating change’ (0.812), ‘use earned value methods’, ‘use Building Information Modelling (BIM)’ (0.814), ‘use risk analysis to understand change implications’ (0.862),’use knowledge-based decision support system (KBDSS)’ (0.928), ’use productivity oriented analysis of design revisions’(0.966), ‘use change prediction system using activity-based dependency structure matrix (DSM)’ (0.99), ‘use trend program’(1), ‘use web-based application for managing change orders in construction projects’(1), ‘use system dynamics’(1), ‘use functional analysis concept design’ (1) and finally ‘use project change triangle tool’(1). It clear based on the frequency index of the last ranking tools that they are never used by contractors in Kuwait. Lack of knowledge about these tools or their complexity may be the main reason behind this the non-usage.

Table 6-21 The ranking of change management practices and tools related to evaluating change

Evaluating change			
Practice/Tool	**Mean**	**Frequency Index**	**Ranking**
Use Microsoft excel to evaluate quantity and/or cost changes	2.17	0.43	1
Use scheduling softwares to evaluate schedule related changes	2.22	0.44	2
Request the expertise of the subcontractor, suppliers or the design consultants if needed	2.79	0.56	3
Use root cause analysis	3.36	0.67	4
Use a change log	3.82	0.76	5
Use records management	4.06	0.81	6
Use standard forms and documentation in evaluating change	4.07	0.81	7
Use earned value methods	4.31	0.86	8
Use Building Information Modelling (BIM)	4.64	0.93	9

Use risk analysis to understand change implications	4.78	0.96	10
Use knowledge-based decision support system (KBDSS)	4.80	0.96	11
Use productivity oriented analysis of design revisions	4.83	0.97	12
Use change prediction system using activity-based dependency structure matrix (DSM)	4.95	0.99	13
Use trend program	5.00	1.00	14
Use web-based application for managing change orders in construction projects	5.00	1.00	14
Use system dynamics	5.00	1.00	14
Use functional analysis concept design	5.00	1.00	14
Use project change triangle tool	5.00	1.00	14

Next, Table 6-22 shows the rankings of the practices and tools related to implementing and monitoring change where also ranked with ‘monitor implemented change and report on a daily, weekly or monthly basis’ (0.352) being the most frequently used practice and subsequently comes ‘use phones, messages and emails to provide updates about the change’ (0.358), ‘gain formal approval from the client prior to change implementation’ (0.362), ‘use Microsoft excel and/or Microsoft word to monitor change’(0.366), ‘implement minor changes that would not affect project parameters and requirements without client approval’ (0.422), ‘use a change log’ (0.694), ‘use standard forms and documentation in implementing and monitoring change’ (0.882), ‘use a Content Management System (CMS) for communication’ (0.906) and finally “use Building Information Modelling (BIM)’ (0.996) comes last. Having BIM as the least frequent option is natural since the awareness of the full capacity of BIM is still in the very first levels in Kuwait. Using BIM to monitor change requires the implementation of this concept and training the relevant team members which has not taken place on a big scale in Kuwait.

Table 6-22 The ranking of change management practices and tools related to implementing and monitoring change

Implementing and monitoring change			
Practice/Tool	**Mean**	**Frequency Index**	**Ranking**
Monitor implemented change and report on a daily, weekly or monthly basis	1.76	0.35	1
Use phones, messages and emails to provide updates about the change	1.79	0.36	2
Gain formal approval from the client prior to change implementation	1.81	0.36	3

Use Microsoft excel and/or Microsoft word to monitor change	1.83	0.37	4
Implement minor changes that would not affect project parameters and requirements without client approval	2.11	0.42	5
Use a change log	3.47	0.69	6
Use standard forms and documentation in implementing and monitoring change	4.41	0.88	7
Use a Content Management System (CMS) for communication	4.53	0.91	8
Use Building Information Modelling (BIM)	4.58	0.92	9

Finally, table 6-23 shows the rankings of the practices and tools used in continuous improvement and learning from previous lessons were ranked. ‘Share experiences through Informal discussions’ (0.496) was the most frequently used practice followed by ‘encourage professional development related to change management’ (0.548), ’share experience through the project close out meeting’ (0.572), ’benchmark the processes outcomes’ (0.588), ’encourage self-driven knowledge and skills enhancement’ (0.59), ’use, update and maintain a change log’ (0.634), ‘use standard forms and documentation in continuously improving from lesson learned’ (0.808) and finally ‘use a Content Management System (CMS) for storing and sharing lessons learned’ (0.874) was ranked last. The main reason why using CMS ranked last may be sourced to the lack of utilising IT in enhancing the record storage and exchanging information therefore would not be used for learning from previously shared or stored lessons in the project.

Table 6-23 The ranking of change management practices and tools related to continuous improvement

Continuous improvement			
Practice/Tool	**Mean**	**Frequency Index**	**Ranking**
Share experiences through Informal discussions	2.48	0.50	1
Encourage professional development related to change management	2.74	0.55	2
Share experience through the project close out meeting	2.86	0.57	3
Benchmark the processes outcomes	2.94	0.59	4
Encourage self-driven knowledge and skills enhancement	2.95	0.59	5
Use, update and maintain a change log	3.17	0.63	6
Use standard forms and documentation in continuously improving from lesson learned	4.04	0.81	7
Use a Content Management System (CMS) for storing and sharing lessons learned	4.37	0.87	8

6.3.7 Stakeholders involvement

The survey investigated the frequency of stakeholders involvement in the process of managing change. This investigation was divided over two separated questions. The first one investigated the involvement of the stakeholders who are employed within the contracting company (internal) while the second question looked into the stakeholders that are outside and not employed within contracting company (external). The ranking of these stakeholders is necessary to understand how the frequency of their involvement is perceived by the respondents. Table 6-24 shows how the internal and external stakeholders are ranked according to their frequency index.

Within the internal stakeholders, the project manager was ranked first (0.402) when it comes to frequency of involvement in the change management process followed by project director (0.404), construction management (0.416), contract manager (0.424), section engineer (0.442), site engineer (0.466), quantity surveyor (0.468), scheduling engineer (0.492), scheduling manager (0.494), designer (0.516), draft person (0.532) and finally the site supervisor (0.546).

On the other hand, the external stakeholders ranking show that private client is the most frequently involved stakeholders (0.516) followed by management consultant (0.534), subcontractor (0.54), design consultant (0.542), supplier (0.55) and ranked last is the public client (0.558). The involvement of the private client is shown to be more frequent than the public client as shown by the results of this survey in addition to the previous preliminary interviews as well. Interviewees indicated on several occasions that the private clients would have input in different stages such as change evaluation and continuous improvement to the contrary of the public client which would not be as cooperative as the private client.

Table 6-24 Internal and external stakeholders involvement frequency ranking

Stakeholders involved in the change management process (Internal)			
Internal Stakeholders	**Mean**	**Frequency Index**	**Ranking**
Project Manager	2.01	0.40	1
Project Director	2.02	0.40	2
Construction Manager	2.08	0.42	3
Contract Manager	2.12	0.42	4
Section Engineer	2.21	0.44	5
Site Engineer	2.33	0.47	6
Quantity Surveyor	2.34	0.47	7
Scheduling Engineer	2.46	0.49	8
Scheduling Manager	2.47	0.49	9
Designer	2.58	0.52	10
Draft Person	2.66	0.53	11
Site Supervisor	2.73	0.55	12
Stakeholders involved in the change management process (External)			
External Stakeholders	**Mean**	**Frequency Index**	**Ranking**
Client (Private Organisation)	2.58	0.52	1
Management Consultant	2.67	0.53	2
Subcontractor	2.70	0.54	3
Design Consultant	2.71	0.54	4
Supplier	2.75	0.55	5
Client (Public Organisation)	2.79	0.56	6

6.3.8 Change Management Problems

The factors that may negatively impact the process of change management was investigated in the survey. The respondents had to show the significance of these problems on a five point scale. Similar to the previous approach, the significance index (SI) was calculated to compare and rank the factors causing problems in the change management process as shown in Table 6-25.

The respondents indicated that 'lack of training' was the most significant factor (0.354) followed by 'lack of a knowledge database '(0.362), 'lack of key stakeholders involvement, support and cooperation' (0.362), 'lack of tools for evaluating the change's effect on quality' (0.364), 'lack of funding' (0.368), 'lack of tools for evaluating the change's effect on cost' (0.37), 'lack of transparency in the organisation' (0.374), 'lack of knowledge exchange between different project teams' (0.38), 'lack of an acceptance/ rejection criteria in change evaluation' (0.38), 'lack of tools for evaluating the change's effect on time' (0.382), 'lack of proper documentation and record keeping' (0.382), 'lack of reporting accuracy' (0.39), 'lack of a standardised process' (0.394), 'lack of a prediction tool to identify change' (0.396), 'inadequate reporting frequency' (0.402) and finally 'inadequate monitoring of the change status' (0.41) was ranked as the least significant factor.

Table 6-25 Ranking of factors that negatively impact the change management process

Factors	Mean	Significance Index	Ranking
Lack of training	1.77	0.35	1
Lack of a knowledge database	1.81	0.36	2
Lack of key stakeholders involvement, support and cooperation	1.81	0.36	2
Lack of tools for evaluating the change's effect on quality	1.82	0.36	3
Lack of funding	1.84	0.37	4
Lack of tools for evaluating the change's effect on cost	1.85	0.37	5
Lack of transparency in the organisation	1.87	0.37	6
Lack of tools for evaluating the change's effect on risks	1.87	0.37	6
Lack of knowledge exchange between different project teams	1.90	0.38	7
Lack of an acceptance/rejection criteria in change evaluation	1.90	0.38	7

Lack of tools for evaluating the change's effect on time	1.91	0.38	8
Lack of proper documentation and record keeping	1.91	0.38	8
Lack of reporting accuracy	1.95	0.39	9
Lack of a standardised process	1.97	0.39	10
Lack of a prediction tool to identify change	1.98	0.40	11
Inadequate reporting frequency	2.01	0.40	12
Inadequate monitoring of the change status	2.05	0.41	13

6.3.9 Change Management Successful Practices and Tools

The conducted survey clearly outlined which practices and tools were favoured amongst contractors in Kuwait when it comes to managing project changes. These practices were be used in creating the capability maturity model in the following chapter. Nonetheless, some of the practices were rated poorly in a way that they do not possess any value from the perspectives of contractors in Kuwait. Therefore, only the clearly prosperous and suitable practices and tools were used in creating the capability maturity model in the next chapter.

Based on the current literature, the approach of choosing the practices to be used in the developed CMM is unclear and varies from one study to the other. Zeb *et al.* (2013) developed the Infrastructure Management-Process Maturity Model (IM-PMM) that contained an evaluation criteria based on the best practices described in the IDM and VISI standards. Arowosegbe and Mohamed (2015) created the Change Management Capability Maturity Assessment Framework for Contracting organisations which used practices that were extracted from an extensive literature review.

Similarly, Zou *et al.* (2010) used the risk management practices extracted from the literature as the evaluation criteria of the risk management maturity model (RM3). Nonetheless, Zou *et al.* (2010) validated these practices through using the expert review method after creating the entire model. Chen *et al.* (2011) created the program management organisation maturity integrated model for mega construction programs (PMOMIM-MCPs) located in China. The model used an evaluation criteria that was heavily based on the one mentioning in the OPM3 model. The evaluation criteria of OPM3 was optimised it to be more suitable for mega projects and their complexities based on the researchers experience. These practices were later on validated by a case study that focuses on applying and Optimising the developed model. Sun *et al.* (2009) developed the Change Management Maturity Model (CM3) based on extracting the important change management practices by using a questionnaire survey followed by interviews to establish the key process areas.

It is unclear whether these interviews were used to further refine the change management practices or if it was for the purpose of grouping these practices under one key process area. Becker *et al.* (2009) selected the evaluation criteria of the IT Performance Measurement Maturity Model ($ITPM^3$) by ensuring that the practices are suitable to solve the current problems encountered in the IT industry. The literature shows that the developed CMM's use a research method (literature review, interviews or questionnaire survey) to find out which practices are successful and directly use these practices as the model's evaluation criteria. Even though a lot of these studies have clearly validated the developed CMM's, the researchers did not mention how the evaluation criteria was refined based on practicality, suitability or correspondence to encountered problems.

For this research, the survey responses were used to eliminate any impractical practices and tools if necessary. Based on the frequency of usage indicated by the survey respondents, some of the practices were deemed completely redundant and unused by contractors in Kuwait. This was indicated by a mean value of 5 for these practices showing that they are never used by any of the respondent's organisations. These tools were sourced to the literature review conducted in this research not the preliminary interviews. After testing the degree of their integration in contracting companies in Kuwait, it was clear that other options were favoured. Therefore, it was deemed impractical and unnecessary to impose these tools on contractors in Kuwait while other tools can also be used to deliver similar outcomes which is essentially evaluating project change as shown in the literature review.

The tools that are not used in Kuwait are the following:

- Use trend program.
- Use web-based application for managing change orders in construction projects.
- Use system dynamics.
- Use functional analysis concept design.

- Use project change triangle tool.

After eliminating these impractical practices and tools, 52 change management criteria are considered successful and can be used to measure the change management capability for contractors in Kuwait.

6.4 SUMMARY

This chapter has pivotal role in this research as the successful criteria of change management was explored and verified on a wide scale using the input of highly experienced professionals working in contracting companies. First, a preliminary semi-structured interview was conducted with industry professionals to validate and expand the list of successful change management criteria in the construction industry of Kuwait. The questions in the preliminary interview aimed to explore the change management process scope and stages used by contractors in Kuwait.

The preliminary interviews were followed by a quantitative questionnaire survey that was distributed to practitioners with beneficial knowledge and experience of the construction industry in Kuwait. The main objective of this questionnaire survey is collecting data from contractors to create a full picture of the change management aspects in Kuwait. These aspects included the practices and tools used to promote a balanced change culture, identify change, evaluate change, implement change and continuous improvement. As as result, the previously created list of change management practices and tools extracted from the preliminary interviews and literature review was reviewed and verified by contractors on a wider scale. A pilot study was undertaken to ensure the validity and effectiveness of the survey instrument before deploying the survey to the target sample. After gaining positive feedback for the pilot survey the full survey was conducted and the data was collected and analysed. The analysis output was the extraction of 52 change management successful criteria that can be later on used to measure the change management capability for contractors in Kuwait.

CHAPTER 7 - CHANGE MANAGEMENT CAPABILITY MATURITY MODEL

7.1 INTRODUCTION

This chapter uses the output of the previous questionnaire survey used in Chapter 6 to create the Change Management Capability Maturity Model (CMCMM). CMCMM should ultimately enhance the contractor's capability in Kuwait to manage project change. This is done through evaluating the change management process conducted within the contracting company and finding the current gaps in practices thus evaluating the current capability of the contractor to manage change. Subsequently, these gaps would then be targeted through improving the practices and tools in order to enhance the contractor's ability to manage project change and ultimately secure better project outcomes. The various creation of the model components is described in this chapter

7.2 ANALYTIC HIERARCHY PROCESS

Based on the previously conducted literature review, it is recognised that all of the CMMs addressing the change management domain have incorrectly addressed the matter of reflecting the varying influence of each evaluation criteria with the model. AHP was used to compare between the evaluation criteria of CMCMM and as a result assigning weights based on the different importance of each criterion. This will in turn reflect the reality of the actual influence for each change management criterion has on the capability to manage change throughout different stages. Decision making could include either objective or subjective attributes. Objective attributes are measurable and represented in numerical form while subjective attributes are not completely measurable within the decision making process. Other research techniques are needed to aid the AHP process in order to get meaningful and beneficial output that can contribute positively to creating the model. Since the AHP comparison was used to compare successful practices and tools within each change management stage, it is clear that this upper limit will be exceeded and consistency issue would emerge as a result. As a result smaller groupings should be created within the stages to enhance the AHP results accuracy and value delivery.

A technique was needed to reduce the practices and tools to a number that can be adequately used within the AHP process. Prior to starting the process of prioritisation between the different elements, it was important to ensure that the upper limit of compared elements is not exceeded. This upper limit is often nine alternatives within each alternatives comparison (Miller, 1956). The first reason for this limit is that the human brain has an information processing limit. This limit allows up to nine binary items as pointed out by Miller (1956). The second reason for preventing the comparison of more than nine alternatives is that the likelihood of human inconsistencies are going to increase drastically which would eventually exceed the 10% consistency threshold set by Saaty (1980).

The reason for this increase in inconsistency is the big number of comparisons needed to cover a big number of elements. Thus a method should be used to decrease the risk of inconsistent results through reducing the compared elements. A reduced number of alternatives would also decrease the amount of time required for comparison by the participants. There is also a need to use another method in addition to the AHP to ensure an adequate degree of consensus between the participants. The Delphi method is generally used for repeatedly extracting expert opinions until reaching a comprehensive consensus on the results (Delbecq *et al.*, 1975). These methods are explained and explored in the following sections.

7.2.1 Dimensions Reduction

52 successful change management criteria were concluded from the questionnaire survey. These criteria were already grouped within the five change management stages. Nonetheless, the number of criteria within each stage is still high and will result in a lack of consistency for each respondent within the AHP process. The outcome of the PCA was a list of Principal Components (PC) that captures the successful change management practices and tools which were previously concluded.

Based on the survey's collected data, the SPSS 24 statistics software was used to conduct the PCA multivariate analysis on five sets of data that represent the change management stages. First, the data adequacy should be checked before using the PCA technique. The dataset were measured using the Kaiser-Meyer-Olkin (KMO) to measure the sampling adequacy to be used for PCA. The KMO values for the data sets were recorded as shown in table 7-1. Since the KMO values for the five data sets were above 0.5, these data sets can be deemed adequate for the use of PCA (Child, 1990 and Field, 2005).

Table 7-1 The KMO values for the five datasets

Data Set	KMO
Promoting a balanced change culture (PCC)	0.89
Identifying Change (IC)	0.85
Evaluating Change (EC)	0.79
Implementing and Monitoring Change (IMC)	0.85
Continuous Improvement (CI)	0.76

Table 7-2 shows the values obtained for the Bartlett's test of sphericity for the five datasets. The test results strongly shows that the population of the five datasets were not an identity matrix.

Table 7-2 The Bartlett's test of sphericity for the five datasets

Data Set	Approx. Chi Square	df	Signifinace
Promoting a balanced change culture (PCC)	929.18	55	0
Identifying Change (IC)	1010.76	66	0
Evaluating Change (EC)	687.21	78	0
Implementing and Monitoring Change (IMC)	808.42	36	0
Continuous Improvement (CI)	343.02	28	0

Subsequently, the data was analysed by using the PCA technique with Varimax rotation. The rotated solution is shown in SPSS 24 by default and is important to understand the final results of the analysis. The next step was that the "Total Variance Explained" table was exported from SPSS 24 and shown in Appendix G. The table shows how the extracted components highly contribute to the cumulative variance of the datasets thus clarifies the number of components that represent the originally collected data. The components with total sums of squared loading of more than 1 was retained (Kaiser, 1960).

The Scree plots shown in figures 7-1, 7-2, 7-3, 7-4 and 7-5 were also exported from SPSS 24 to show the number of principal components acquired (Jupp, 2006) and support the output from the "Total Variance Explained" table (Dogbegah *et al.*, 2011).

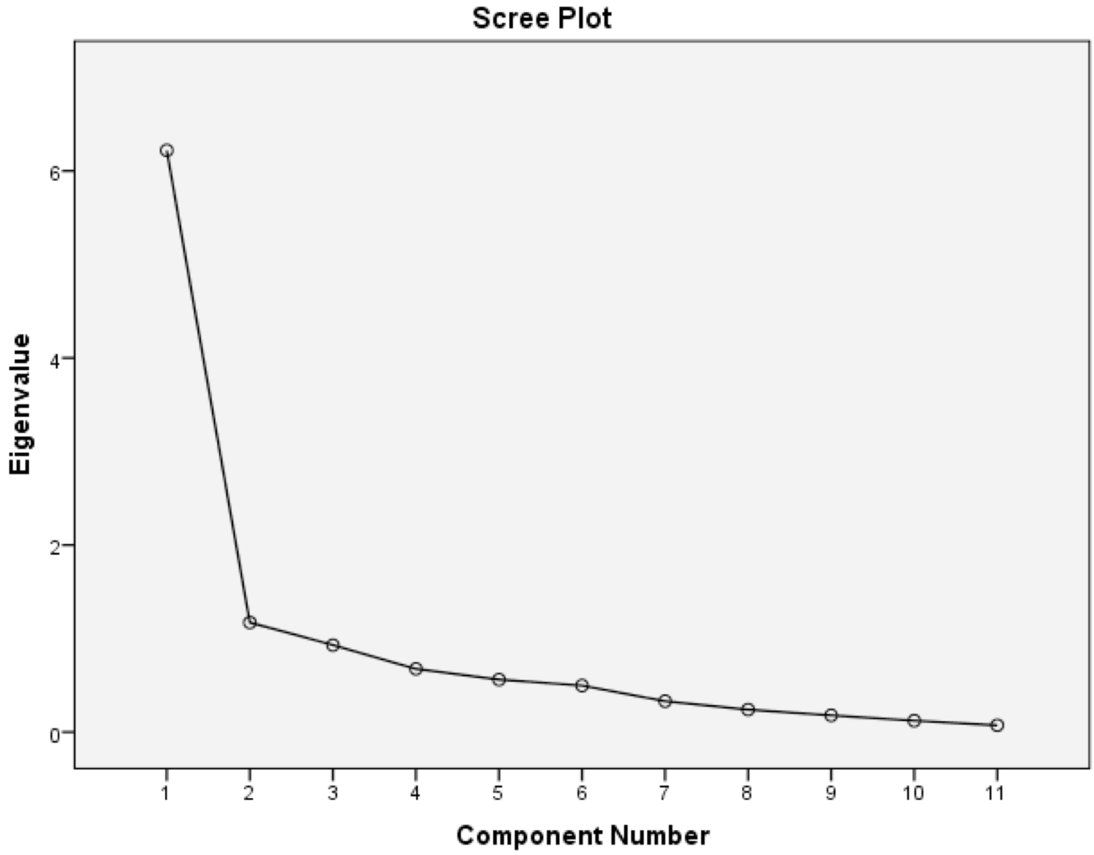

Figure 7-1 The Scree plot for the "Promoting a balanced change culture" dataset

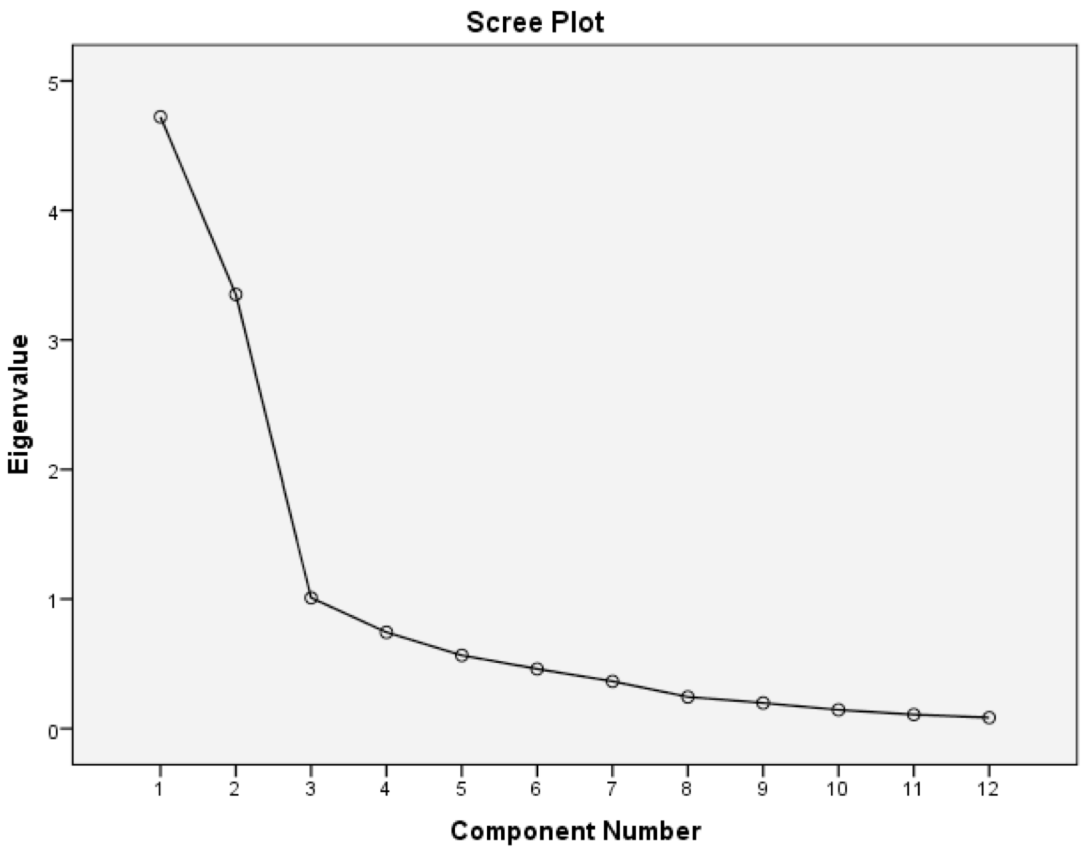

Figure 7-2 The Scree plot for the "Identifying change" dataset

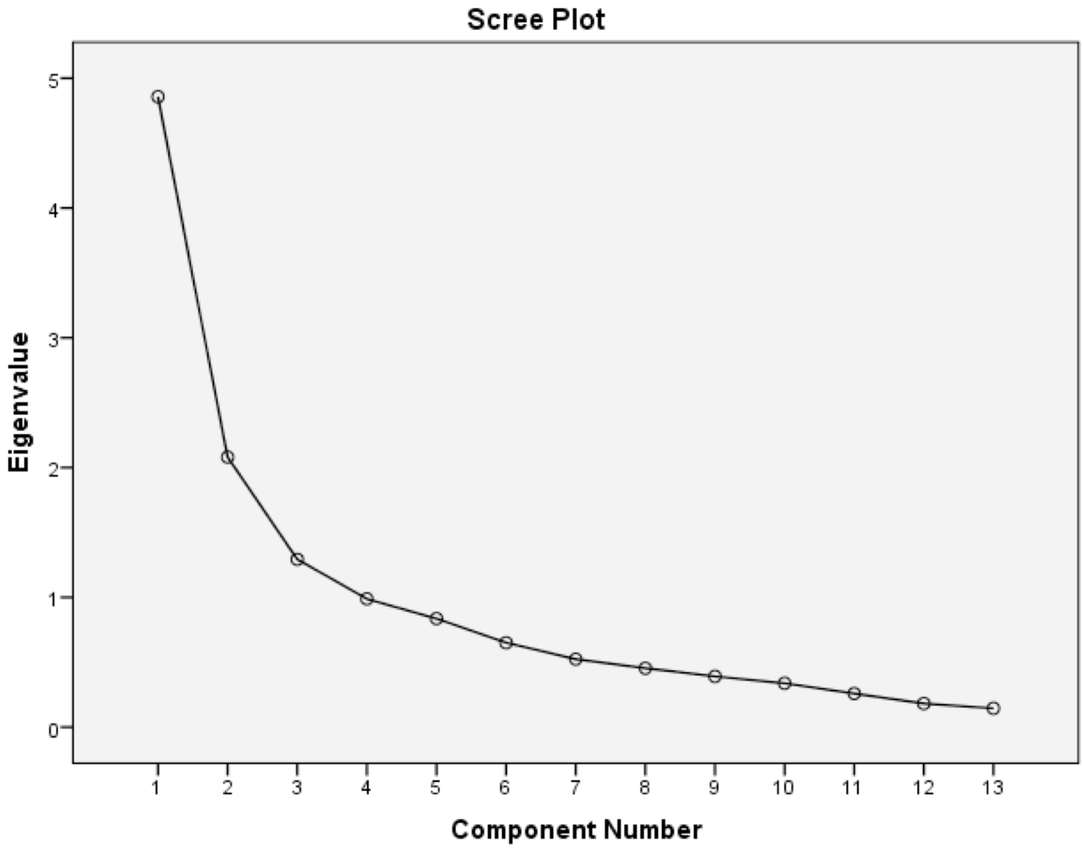

Figure 7-3 The Scree plot for the "Evaluating change" dataset

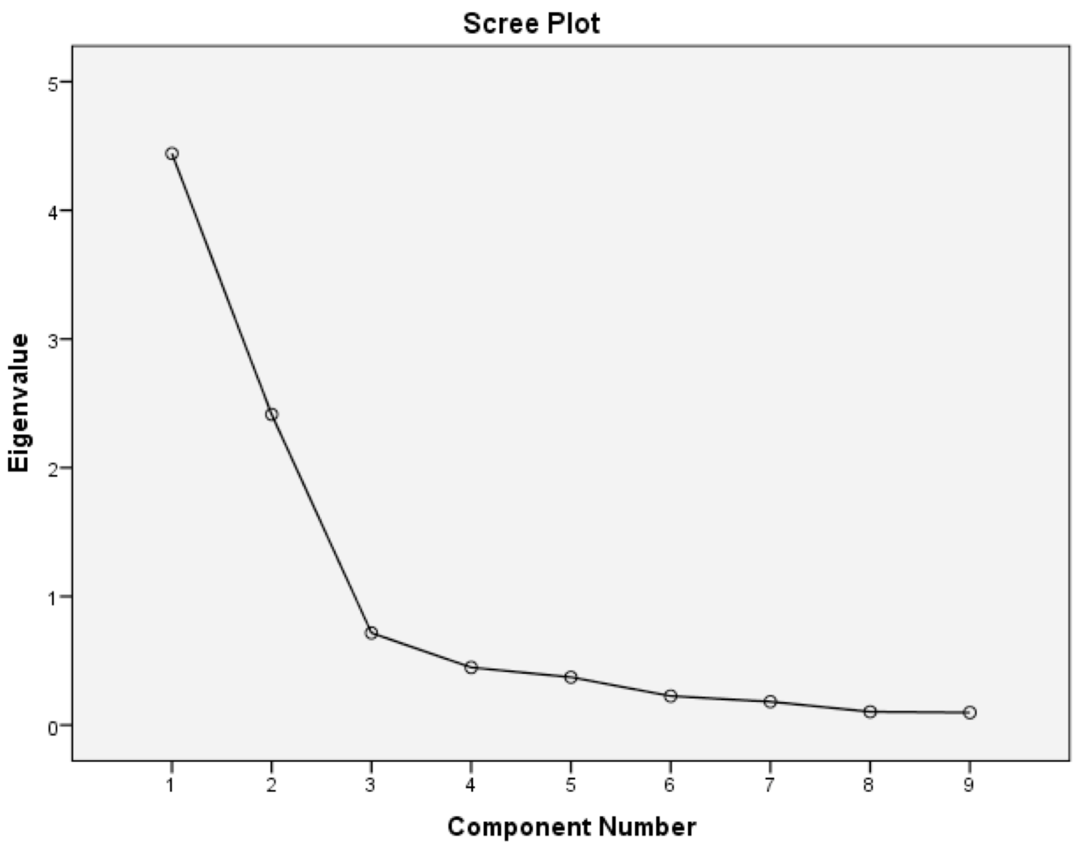

Figure 7-4 The Scree plot for the "Implementing and monitoring change" dataset

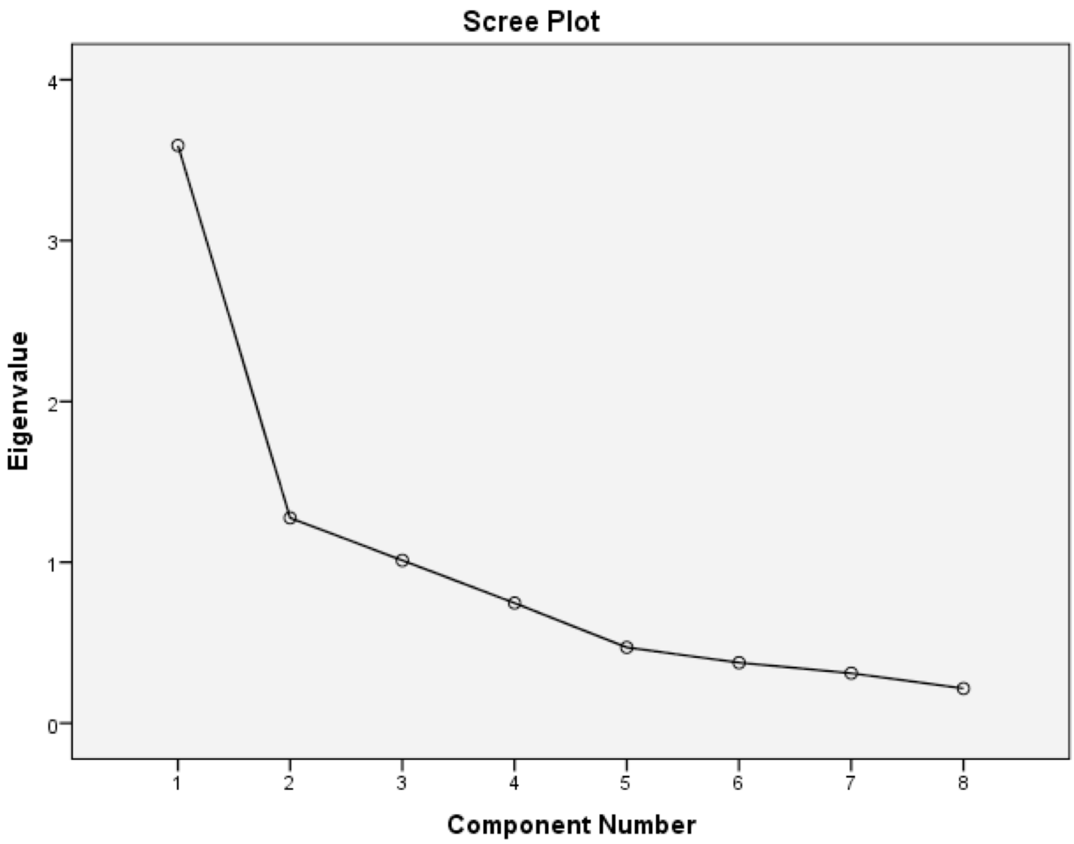

Figure 7-5 The Scree plot for the "Continuous improvement" dataset

Based on the results, the PCC dataset can be represented by 2 principal components, IC dataset by 3 components, EC dataset by 3 components, IMC dataset by 2 components and finally the CNT dataset can be represented by 2 principal components. For instance, the "PCC" dataset has two principal components that explains that variance in the data. The first component accounted for 56.539% of the total variance while the second component accounted for 10.649%. This shows that both principal components explain a total of 67.188% of the variation in the dataset. Other datasets had 3 principal components that explains the dataset variation as shown in Appendix G.

Next, the rotated component matrix of the PCA was analysed to observe the loading on each of the principal component.The rotated component matrices for each of the five datasets are shown in Appendix H.

The next task was to describe the principal components of each dataset and show which change management criterion is represented by the component. Each criterion was grouped under the principal component that has higher correlation with the criterion. For instance PCC_1, has a loading of 0.661 on PC_PCC_1 while it has a loading of 0.533

with PC_PCC_2. This means that PCC_1 is better represented by PC_PCC_1 since the correlation between PCC_1 and PC_PCC_1 is higher than the correlation between P_CC1 and PC_PCC_2. Appendix H also shows the plots of the criteria's loading on the principal components. These plots are presented in either 2D or 3D representation according to the number of retained principal components. If two principal components were retained, a 2D scatter plot was used while a 3D scatter plot was used if three principal components were retained.

Additionally, Table 7-3 shows all the 52 change management practices and tools that were previously concluded with their representing principal components based on the loading of each practice. The codings used were the same as the ones featured in Appendix F and used previously in the survey data analysis. Based on the concluded principal components, the change management practices and tools were sorted into groups of elements that are less than nine. Based on the same grouping the AHP comparisons would offer a higher consistency.

Table 7-3 The principal components representation of change management practices and tools

Principal Component	Change Management Practice/Tool
PC_PCC_1	PCC_1
	PCC_2
	PCC_3
	PCC_8
	PCC_10
	PCC_11
PC_PCC_2	PCC_4
	PCC_5
	PCC_6
	PCC_7
	PCC_9
PC_IC_1	IC_1
	IC_2
	IC_3
	IC_4
	IC_5

Principal Component	Change Management Practice/Tool
	IC_6
PC_IC_2	IC_8
	IC_9
	IC_10
PC_IC_3	IC_7
	IC_11
	IC_12
PC_EC_1	EC_8
	EC_11
	EC_13
	EC_17
	EC_18
PC_EC_2	EC_6
	EC_7
	EC_10
	EC_12
PC_EC_3	EC_14
	EC_15
	EC_16
PC_IMC_1	IMC_1
	IMC_2
	IMC_3
	IMC_4
	IMC_5
PC_IMC_2	IMC_6
	IMC_7
	IMC_8
	IMC_9
PC_CNT_1	CNT_3
	CNT_6
	CNT_7
	CNT_1

Principal Component	Change Management Practice/Tool
PC_CNT_2	CNT_2
	CNT_4
	CNT_5
	CNT_8

7.2.2 The Delphi Technique

As shown in the used methodology section presented in Chapter 5, using the Delphi technique in conjunction with the AHP process can be used to collect data through multiple iterations in order to reach an acceptable degree of consensus between the participants (Taleai & Mansourian, 2008). Therefore, the Delphi technique was used to collect data through multiple rounds and assure that consensus amongst participants was achieved. Consensus was measured through the coefficient of variation (CV) and was considered acceptable if less than 50% (Dajani *et al.*, 1979).

7.2.3 AHP Interviews

One of the most common methods to collect data in the AHP process is through questionnaire surveys that are conducted face to face with a panel of experts that possess deep knowledge in the subject area (Mughrabi *et al.*, 2017; Brugarolas *et al.*, 2010). The interviews were designed in a structured fashion (Mughrabi *et al.*, 2017) that enables the experts to choose within a preset scale known as the AHP scale which is a qualitative scale (Bhushan & Rai, 2007). The scale compares between the relative significance of two elements. The elements compared are the practices and tools from the change management concluded from the questionnaire survey, preliminary interviews and literature review.

The comparison was done between the change management criteria that are used within a particular change management stage (i.e., promote a balanced change culture, identify change, evaluate change, implement change and continuous improvement). The reason is that the relative significance was needed between the practices and tools within the stage they are used in for the purpose of creating CMCMM. The comparison between two practices or tools in two different change management stages would not add any value in the creation of CMCMM or for the end-user. Based the CMMI, the developed model should typically include knowledge areas that are composed of specific goals and specific practices. Specific practices are required to be conducted to achieve the specific goal. The specific goals are grouped within the knowledge area which in this case is the particular change management stage. The specific practices are all conducted to satisfy the specific goal that is required within the KPA that represents a specific change management stage.

As previously mentioned, the consistency ratio is critical to the AHP process and could be increased through decreasing the number of compared elements in each comparison. As a result, PCA was used to find the principal components that represent the change practices and tools. Twelve principal components were concluded to represent three or more change management practices and tools. As a result, twelve groups were created and were used as a basis for comparison in the AHP process. On this basis, twelve comparisons were requested for completion by the AHP participants. These groupings were be used later on to represent the relative significance of each change management practice and tool.

AHP was used to assign weights to the specific practices for each change management stage. In other words, the relative importance of the specific practices grouped within a specific goal was compared in addition to comparing the relative importance of the specific goals within each key process area. For instance, if the significance of a specific practice is 40% while the significance of the specific goal containing it is 70%, this means that the overall significance of this practice (in comparison with all the practices within the change management stage itself) is equal to 28%.

Appendix I shows the interviews that compare between the change management practices and tools that were built on the basis of the PCA technique. These interviews should be distributed as many times as needed to establish a high degree of agreement between the participants.

7.2.4 Expert Panel Selection

The first step in selecting the expert panel, the size of this panel should be indicated. There are no fix set of rules that determines the size of the experts in the panel as it may range from 4 to 3000 experts (Thangaratinam & Redman, 2005). A pragmatic approach should be adopted to determine the size of the panel in terms of time and expense for completing the process (Thangaratinam & Redman, 2005). When observing the necessities of using the Delphi technique, it can be confirmed that having a minimum of seven to eight participants is sufficient for the process (Sourani & Sohail, 2015) as the Delphi expert panel is assessed by its knowledge and expertise rather than the number of participants (Powell, 2003). Evidently, the Delphi panel size can range between 3 to 98 and provide satisfactory results (Rowe & Wright, 1999).

The next step is selecting the expert panel is concerned with the suitability of the participants' knowledge and expertise to produce valid and rich responses. The expert panel should include academics who have knowledge in the field of project management and specifically change management and continuous improvement processes in the Kuwaiti construction industry. Industry professionals with valuable experience formed an essential part of the expert panel. This combination of experts assured the suitability of the relative importance to the local industry since extracting the experience of only industry professionals may be constrained and not account for potential improvements that could be integrated in the industry. The experts should have a minimum of 10 years of experience in either academia, industry or both. This experience should be in the project management domain and specifically in project change management. Additionally, this experience should be conducted in or related to the Kuwaiti construction industry. It is also beneficial to include participants who have previously contributed to this research to ensure the involvement of experienced professionals with a prior background of the research topic (Powel, 2003).

Since the process of collecting data through the Delphi technique could potentially be time consuming and would require several iterations of feedback and data collection, the participants confirmation to take part in the necessary Delphi rounds as needed is considered essential prior to choosing the participants (Powell, 2003).

7.2.5 Expert Panel Demographics

The demographics of the participants were investigated in the first part of the survey. The demographics collected were concerned with the current position, years of experience, nature of experience and the type of organisation (industry or academia). A confirmation was acquired from the survey participants in order to make sure that they were committed to the required rounds in the Delphi technique.

After contacting fifteen eligible candidates in order to schedule the face to face survey, only eight provided the consent to commit to this research requirement and participate as needed in all the delphi rounds required. Six participants are currently employed in the industry and two are working in academia and are active researchers in the field of construction management. The positions of the participants are mentioned in Table 7-4. The positions of the participants includes project director, project manager, construction manager, associate professor and assistant professor. The industry related participants previously contributed in the questionnaire survey of this survey. Having these participants is an advantage to this research since prior knowledge in the topic would be beneficial to the outcome of the AHP process. The academics who participated in the survey, had a deep knowledge and a research history in construction management and the AHP process and are currently employed as faculty members in the school of engineering. The years of experience were also a point of focus to ensure valid input is secured in the survey as shown in Table 7-5. A minimum of 10 years of relevant experience in either academia or industry was required to participate in the survey. The range of experiences selected for participation should secure a meaningful output for the AHP process.

Table 7-4 The participants positions

What is your role in the organisation?		
Responses	**Response Percent**	**Number of Responses**
Project Director	12.50%	1
Project Manager	37.50%	3
Construction Manager	25.00%	2
Associate Professor	12.50%	1
Assistant Professor	12.50%	1

Table 7-5 The participants years of experience

What is the number of years of experience do you have?		
Responses	**Response Percent**	**Number of Responses**
10-15 Years	25.00%	2
16-20 Years	37.50%	3
21-25 Years	25.00%	2
More than 25 Years	12.50%	1

7.2.6 AHP Calculations

An AHP calculator developed by Goepel (2013) was used in this stage in order to facilitate the necessary calculations. This calculator proved to be effective and genuine in several domains dealing with AHP. Markelj *et al.* (2014) used this AHP calculator to evaluate the sustainability of building design in the early design phases and proved the authenticity of this calculator. Mohammadi & Limaei (2014) used the calculator developed by Goepel (2013) for selecting the essential criteria required for urban forestry in Iran. Mughrabi *et al.* (2017) also used the same calculator to assign weights for learning outcomes within project based learning units.

Nonetheless, to validate the integrity of the calculator, the two AHP example that were previewed by Coyle (2004) were used to ensure that the calculator would yield the correct output when using these particular inputs. The calculator provided the same results when it came to calculating the eigenvalue, the consistency ratio and the elements weights. On the basis of this verification and the utilisation of this calculator in other published researches, it was deemed fit to be used for this research. Furthermore, the calculator was enhanced to account for the coefficient of variation (CV) in order to explore the degree of consensus between the participants.

The data were collected by allowing the participants to set their preferences on an AHP scale (Bhushan & Rai, 2007) and indicate the preference of the compared elements' significance as shown in Figure 7-6 .

	Extreme		Strong		Moderate		Weak or Slight		Equal		Weak or Slight		Moderate		Strong		Extreme	
Element 1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Element 2

Figure 7-6 AHP scale

Next, the results were then organised into square matrix as shown in figure 7-7. The diagonal elements of the matrix is naturally equal to 1. This is due to these elements representation of comparing each criterion to itself If the element value of element (i, j) is more than 1, this indicates that criterion in the ith row is better than the criterion in the jth column. On the other hand, if the element value of element (i, j) is less than 1, this indicates that criterion in the ith row was less prioritised than the criterion in the jth column. Additionally, the (j, i) element of the matrix is always the reciprocal of the (i, j) element as mentioned by Bhushan & Rai (2007).

	X	**Y**	**Z**
X	1	9	3
Y	1/9	1	5
Z	1/3	1/5	1

Figure 7-7 AHP matrix

The following step is generating the eigen-vector of the matrix and indicate the relative importance of the criteria being compared. The eigen-vector is then normalised and the elements of the vector are named weights when it comes to determining the importance of the criteria.

Finally, the consistency of the resulting weights is tested to account for the subjectivity of the approach within the limits of AHP tolerance. Failing in the consistency test will necessitate relapsing the same process again till an acceptable consistency is obtained. The consistency test starts with finding the matrix order (number of rows and columns used) which is denoted by n. Additionally, λ_{max} which is the principle eigen value should be found. According to Bhushan & Rai (2007) following equation could be used to find the consistency index (CI):

$CI = (\lambda_{max}-n)/(n-1)$

The CI concluded is then compared to a random consistency index (RI) which is based on the random matrix. RI is given by different studies depending on the matrix order (n) as shown in table 7-6. CI/RI which is known as the consistency ratio (CR) should be less than 0.1 (10%) according to (Saaty, 1980). Otherwise, the subjective opinion is considered inconsistent and should be revisited by the participant.

Table 7-6 Random Consistency Index (RI) for "n" number of elements

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.48	1.49

Next, the opinions of various individuals participating should be aggregated in the weighting of the criteria to get a wholistic weighting to be used in the study. The summarised AHP weights method entails that all the weights extracted from the participators were added to determine which weight has the highest mean value and then rank the criteria accordingly.

The coefficient of variation (CV) was calculated for each element. It is calculated by dividing the standard deviation of the element's weights (as provided by each participant) over the mean value of the element weight (the mean of the weights provided by all the participants).

A single data collection round was not adequate to obtain sufficient and valid output by the participants. As a result two rounds of data collection was necessary to obtain the necessary participant decision consistencies and an acceptable consensus. The details of the calculations of each Delphi rounds are shown in the following sections.

7.2.7 Data Analysis (Delphi's first round)

In the first Delphi round, the participants were requested to compare between the elements through individual surveys that were filled face to face. The researcher was available to make sure that any clarifications would be provided to improve the input quality.

The twelve comparisons were completed and compiled in the aggregated AHP matrix in addition to subsequently calculating the normalised eigenvectors for each comparison as shown in Figures 7-8, 7-10, 7-12, 7-14, 7-16, 7-18, 7-20, 7-22, 7-24, 7-26, 7-28 and 7-30. The values shown in the normalised eigenvector represents the weights of each element based on the responses of the participants. On this basis the ranking of the elements for each comparison was created as shown in Figures 7-9, 7-11, 7-13, 7-15, 7-17, 7-19, 7-21, 7-23, 7-25, 7-27, 7-29 and 7-31.

It is also shown in these figures that the coefficient of variation (CV) was calculated for each element to determine the degree of consensus. When CV was above 50%, consensus was considered not achieved and the cell would be highlighted as an indication. This is consistent to the requirement of Dajani *et al. (*1979) of achieving a CV which is less than 50% in order to consider that consensus was reached. Therefore and in many cases, consensus was not considered achieved to an acceptable degree which required conducting another round of data collection to obtain adequate results and possible achieve consensus amongst participants.

Matrix

		PCC_1	PCC_2	PCC_3	PCC_8	PCC_10	PCC_11	normalized principal Eigenvector
		1	2	3	4	5	6	
PCC_1	1	-	7/8	1 3/5	1	5/8	2 3/5	17.75%
PCC_2	2	1 1/7	-	3/8	1 2/9	2/7	3 1/3	12.89%
PCC_3	3	5/8	2 5/7	-	2 1/3	2 1/4	3 2/5	27.25%
PCC_8	4	1	4/5	3/7	-	1/2	3	12.44%
PCC_10	5	1 3/5	3 4/7	4/9	2	-	4	24.31%
PCC_11	6	2/5	1/3	2/7	1/3	1/4	-	5.36%

Figure 7-8 PC_PCC_1 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	PCC_1	17.8%	3	38%
2	PCC_2	12.9%	4	27%
3	PCC_3	27.2%	1	39%
4	PCC_8	12.4%	5	23%
5	PCC_10	24.3%	2	19%
6	PCC_11	5.4%	6	82%

Figure 7-9 PC_PCC_1 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		PCC_4	PCC_5	PCC_6	PCC_7	PCC_9	normalized principal Eigenvector
		1	2	3	4	5	
PCC_4	1	-	3 4/9	4	2	3 1/4	42.10%
PCC_5	2	2/7	-	2 5/8	1 1/7	1	17.25%
PCC_6	3	1/4	3/8	-	2/5	1 6/7	10.72%
PCC_7	4	1/2	7/8	2 1/2	-	1 1/3	18.40%
PCC_9	5	1/3	1	1/2	3/4	-	11.52%

Figure 7-10 PC_PCC_2 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	PCC_4	42.1%	1	22%
2	PCC_5	17.3%	3	54%
3	PCC_6	10.7%	5	66%
4	PCC_7	18.4%	2	57%
5	PCC_9	11.5%	4	35%

Figure 7-11 PC_PCC_2 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		IC_1	IC_2	IC_3	IC_4	IC_5	IC_6	normalized principal Eigenvector
		1	2	3	4	5	6	
IC_1	1	-	1 5/6	4/5	1 5/7	1 1/3	2 1/2	22.08%
IC_2	2	5/9	-	7/9	1 2/5	5/8	2 7/8	15.80%
IC_3	3	1 2/9	1 2/7	-	2 4/5	7/8	2 1/5	22.26%
IC_4	4	4/7	5/7	1/3	-	1/2	2 1/8	11.57%
IC_5	5	3/4	1 3/5	1 1/7	2	-	1 6/7	20.34%
IC_6	6	2/5	1/3	1/2	1/2	1/2	-	7.95%

Figure 7-12 PC_IC_1 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	IC_1	22.1%	2	34%
2	IC_2	15.8%	4	39%
3	IC_3	22.3%	1	40%
4	IC_4	11.6%	5	90%
5	IC_5	20.3%	3	31%
6	IC_6	8.0%	6	33%

Figure 7-13 PC_IC_1 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		IC_8	IC_9	IC_10	normalized principal Eigenvector
		1	2	3	
IC_8	1	-	5/9	2/3	22.66%
IC_9	2	1 4/5	-	2	49.05%
IC_10	3	1 1/2	1/2	-	28.29%

Figure 7-14 PC_IC_2 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	IC_8	22.7%	3	65%
2	IC_9	49.1%	1	41%
3	IC_10	28.3%	2	57%

Figure 7-15 PC_IC_2 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		IC_7	IC_11	IC_12	normalized principal Eigenvector
		1	2	3	
IC_7	1	-	2/3	2/7	17.01%
IC_11	2	1 4/9	-	2/5	24.37%
IC_12	3	3 2/5	2 3/7	-	58.62%

Figure 7-16 PC_IC_3 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	IC_7	17.0%	3	31%
2	IC_11	24.4%	2	89%
3	IC_12	58.6%	1	31%

Figure 7-17 PC_IC_3 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		EC_8	EC_11	EC_13	EC_17	EC_18	normalized principal Eigenvector
		1	2	3	4	5	
EC_8	1	-	1 5/7	2 1/5	1 2/5	1	26.19%
EC_11	2	4/7	-	1 2/5	2 4/7	1 3/4	25.79%
EC_13	3	1/2	5/7	-	3/7	3/5	11.19%
EC_17	4	5/7	2/5	2 1/3	-	2 2/7	20.96%
EC_18	5	1	4/7	1 2/3	4/9	-	15.87%

Figure 7-18 PC_EC_1 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	EC_8	26.2%	1	57%
2	EC_11	25.8%	2	49%
3	EC_13	11.2%	5	86%
4	EC_17	21.0%	3	47%
5	EC_18	15.9%	4	28%

Figure 7-19 PC_EC_1 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		EC_6 1	EC_7 2	EC_10 3	EC_12 4
EC_6	1	-	6 1/9	8 1/9	4 1/3
EC_7	2	1/6	-	1	1
EC_10	3	1/8	1	-	4/7
EC_12	4	1/4	1	1 5/7	-

normalized principal Eigenvector

66.07%
11.10%
9.01%
13.82%

Figure 7-20 PC_EC_2 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	EC_6	66.1%	1	3%
2	EC_7	11.1%	3	9%
3	EC_10	9.0%	4	22%
4	EC_12	13.8%	2	17%

Figure 7-21 PC_EC_2 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		EC_14 1	EC_15 2	EC_16 3
EC_14	1	-	1/6	1/5
EC_15	2	5 5/7	-	1 2/5
EC_16	3	5 3/8	5/7	-

normalized principal Eigenvector

8.21%
51.68%
40.11%

Figure 7-22 PC_EC_3 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	EC_14	8.2%	3	21%
2	EC_15	51.7%	1	34%
3	EC_16	40.1%	2	43%

Figure 7-23 PC_EC_3 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		IMC_1 1	IMC_2 2	IMC_3 3	IMC_4 4	IMC_5 5	normalized principal Eigenvector
IMC_1	1	-	2	1 1/7	1/4	2	18.29%
IMC_2	2	1/2	-	4/7	2/7	7/8	10.27%
IMC_3	3	7/8	1 5/7	-	7/9	2	20.82%
IMC_4	4	4 1/6	3 3/8	1 2/7	-	2 1/5	38.88%
IMC_5	5	1/2	1 1/7	1/2	1/2	-	11.75%

Figure 7-24 PC_IMC_1 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	IMC_1	18.3%	3	31%
2	IMC_2	10.3%	5	95%
3	IMC_3	20.8%	2	46%
4	IMC_4	38.9%	1	44%
5	IMC_5	11.8%	4	83%

Figure 7-25 PC_IMC_1 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		IMC_6 1	IMC_7 2	IMC_8 3	IMC_9 4	normalized principal Eigenvector
IMC_6	1	-	1 3/4	1 2/3	2 7/8	38.74%
IMC_7	2	4/7	-	2 2/5	2 4/5	31.50%
IMC_8	3	3/5	2/5	-	3/5	14.40%
IMC_9	4	1/3	1/3	1 2/3	-	15.36%

Figure 7-26 PC_IMC_2 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	IMC_6	38.7%	1	50%
2	IMC_7	31.5%	2	39%
3	IMC_8	14.4%	4	38%
4	IMC_9	15.4%	3	76%

Figure 7-27 PC_IMC_2 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		CNT_3	CNT_6	CNT_7	normalized principal Eigenvector
		1	2	3	
CNT_3	1	-	1/6	3/8	10.88%
CNT_6	2	5 2/3	-	1 5/7	57.69%
CNT_7	3	2 5/7	4/7	-	31.44%

Figure 7-28 PC_CNT_1 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	CNT_3	10.9%	3	37%
2	CNT_6	57.7%	1	29%
3	CNT_7	31.4%	2	59%

Figure 7-29 PC_CNT_1 weights, ranking and coefficient of variation (Delphi round 1)

Matrix

		CNT_1	CNT_2	CNT_4	CNT_5	CNT_8	normalized principal Eigenvector
		1	2	3	4	5	
CNT_1	1	-	2/7	2	1 1/7	1 1/2	18.58%
CNT_2	2	3 1/2	-	2 1/4	1 1/7	1 5/9	33.07%
CNT_4	3	1/2	4/9	-	1/2	2/3	10.74%
CNT_5	4	7/8	7/8	2 1/8	-	1 6/7	22.72%
CNT_8	5	2/3	2/3	1 1/2	1/2	-	14.89%

Figure 7-30 PC_CNT_2 AHP matrix (Delphi round 1)

	Criterion	Weights	Rk	CV
1	CNT_1	18.6%	3	37%
2	CNT_2	33.1%	1	30%
3	CNT_4	10.7%	5	85%
4	CNT_5	22.7%	2	29%
5	CNT_8	14.9%	4	65%

Figure 7-31 PC_CNT_2 weights, ranking and coefficient of variation (Delphi round 1)

It is also recognised through Table 7-7 that the consistency ratio (CR) for various responses was above the allowed threshold (10%). Therefore these responses needs to be revisited for increasing its consistency in order to be considered valid for usage in this research. The table shows how the consistency ratios are different from one participant to the other. The mean CR for each participant was calculated to gain a better perspective of their ability to complete this task. The mean CR is considerably high when compared to the maximum threshold where all the participants except the first participant had an mean CR that is above 14%. That range of consistency is also considered high. The participant providing the least consistent responses had a mean CR of approximately three times more than the mean CR of the participant providing the most consistent feedback.

When observing the responses, it was clear that the inconsistencies could be sourced to two main triggers. The first reason of inconsistency was the exaggeration of choices and the use of extreme values by the participants to represent their opinions. For instance, some participants would select that one element compared to the other has the significance of "9" while being consistent would require the selection of "3". The second reason for inconsistency was the contradiction of opinion. In other words, while the selection of the participant would entail that one element is potentially more important than the other, the participant would choose other wise. This reflects a shift of opinion at each element comparison thus produced an inconsistency within the results.

To prevent these causes, the second round ensured that the participants would be informed about the main factors that caused a low consistency in their responses in the first round in addition to receiving tailored recommendations.

It is apparent that the results in this round suffered from both inconsistent comparisons and a lack of consensus. On this basis, another round was required to collect more consistent responses and achieve a higher degree of consensus. The only comparison that does not need to be repeated for the next round was PC_EC_2 since the consistency ratios for all the participants was less than 10% in addition to having an acceptable consensus with a coefficient of variation ranging between 3% to 22% which is acceptable as it is less than 50%.

Table 7-7 Consistency ratio of the participants' responses (Delphi round 1)

	Participants							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
PC_PCC_1	25.00%	16.00%	16.00%	49.00%	21.00%	36.00%	32.00%	26.00%
PC_PCC_2	9.00%	5.00%	14.00%	34.00%	38.00%	35.00%	37.00%	30.00%
PC_IC_1	9.00%	17.00%	14.00%	55.00%	20.00%	8.00%	8.00%	26.00%
PC_IC_2	14.00%	31.00%	14.00%	4.00%	0.00%	14.00%	7.00%	3.00%
PC_IC_3	3.00%	1.00%	1.00%	45.00%	4.00%	31.00%	4.00%	3.00%
PC_EC_1	23.00%	13.00%	26.00%	30.00%	17.00%	54.00%	21.00%	7.00%
PC_EC_2	5.00%	2.00%	1.00%	6.00%	9.00%	2.00%	5.00%	2.00%
PC_EC_3	3.00%	59.00%	1.00%	14.00%	19.00%	0.00%	59.00%	14.00%
PC_IMC_1	7.00%	25.00%	5.00%	31.00%	31.00%	14.00%	19.00%	8.00%
PC_IMC_2	5.00%	21.00%	31.00%	33.00%	6.00%	32.00%	55.00%	27.00%
PC_CNT_1	4.00%	14.00%	31.00%	3.00%	31.00%	14.00%	45.00%	45.00%
PC_CNT_2	7.00%	39.00%	20.00%	43.00%	29.00%	21.00%	22.00%	16.00%
Mean	**9.50%**	**20.25%**	**14.50%**	**28.92%**	**18.75%**	**21.75%**	**26.17%**	**17.25%**

7.2.8 Data Analysis (Delphi's second round)

Based on the inconsistent feedback and lack of consensus of the first round, a second round of data collection was deemed necessary for the AHP process. In this round, a summary of the first round's results was shown to the same participants prior to requesting that they repeat completing the same comparisons. As expected, and after being exposed to the first round results, the participants provided more reliable answers with a noticeably higher consensus.

One of the big improvements witnessed in the second round is that the extreme values provided by the participants in the first round were decreased drastically. The consensus was also enhanced to a satisfactory level (CV was less than 50%) in the second round. Some participants were asking questions about the first round results and trying to understand why the ranking turned out to be that way. The author as a result clarified and further elaborated on the meaning of the relevant change management practices and tools as a step to close the gap of perspectives that was present in the first round.

The author also provided the participants with guidelines for improving the consistency ratio of their decisions based on their answers in the first round. Some suggestions targeted the extreme values that were causing inconsistency while others were focused on making decisions that are less contradictory. Some of these suggestions were accepted by the while others were turned down by the participants. The author avoided influencing the participants' opinions and rather focused on empowering their choices by increasing the consistency of their decisions of elements prioritisation. Another tip shared with the participants was illustrating how to resemble the importance of each element for various comparisons through a simple example. For instance, if A is two times more important than B and B is three times more important than C, then A should reasonably be six times more important than C. Indicating otherwise would decrease the participants perceived uniformity in providing responses and worsen the consistency the ratio.

Similar to the previous round, the twelve comparisons were completed and compiled in the aggregated AHP matrix in addition to subsequently calculating the normalised eigenvectors for each comparison as shown in Figures 7-32, 7-34, 7-36, 7-38, 7-40, 7-42, 7-44, 7-46, 7-48, 7-50, 7-52 and 7-54. The values shown in the normalised eigenvector represents the weights of each element based on the responses of the participants. On this basis the ranking of the elements for each comparison was created as shown in Figures

7-33, 7-35, 7-37, 7-39, 7-41, 7-43, 7-45, 7-47, 7-49, 7-51, 7-53 and 7-55. These figures also show calculated coefficient of variation (CV) which clearly indicated that the participants have an adequate level of agreement towards the significance of the compared change management practices and tools.

When comparing the ranking of different CM practices in the first and the second round, only a minimal difference exist. Table 7-8 shows the changed rankings of change management practices and tools when comparing the first round outcome with the second round results. It can be noticed that the elements that had a change in ranking in the second round originally had a weight value that is close to another element in the first round. As a result, a minimal change in opinion due to the Delphi technique caused a shift in ranking between the two elements having a close significance value. For example, EC11 had the weight of 25.8% in the first round while EC17 had the consecutive bigger weight which was 21%. In the second round, a slight shift in perspective caused the ranking to change due to EC11 having 22.1% weight while EC17 having the 23.5%. In other words, the two original weights from the first round had a small difference in values which enabled the shift of ranking after the opinions of the participants changed in the second round due to the Delphi technique.

Table 7-8 Elements with different ranking (comparison between Delphi round 1 & 2)

	EC11	**EC17**	**IMC1**	**IMC3**	**IMC8**	**IMC9**
Round 1	2	3	3	2	4	3
Round 2	3	2	2	3	3	4

Matrix

		PCC_1	PCC_2	PCC_3	PCC_8	PCC_10	PCC_11	normalized principal Eigenvector
		1	2	3	4	5	6	
PCC_1	1	-	1	1	1 1/4	5/7	3 3/8	17.75%
PCC_2	2	1	-	1/2	1	1/2	2 3/5	13.60%
PCC_3	3	1	2	-	2 1/3	1 3/5	5 1/7	27.04%
PCC_8	4	4/5	1	3/7	-	1/2	3 7/8	13.45%
PCC_10	5	1 2/5	2 1/5	5/8	2	-	4 1/2	23.38%
PCC_11	6	2/7	2/5	1/5	1/4	2/9	-	4.77%

Figure 7-32 PC_PCC_1 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	PCC_1	17.7%	3	44%
2	PCC_2	13.6%	4	40%
3	PCC_3	27.0%	1	39%
4	PCC_8	13.5%	5	22%
5	PCC_10	23.4%	2	29%
6	PCC_11	4.8%	6	33%

Figure 7-33 PC_PCC_1 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		PCC_4	PCC_5	PCC_6	PCC_7	PCC_9	normalized principal Eigenvector
		1	2	3	4	5	
PCC_4	1	-	2 1/5	4 1/3	2 3/7	4 1/3	42.17%
PCC_5	2	4/9	-	2 5/7	4/5	1 1/2	18.29%
PCC_6	3	1/4	3/8	-	3/8	1 1/4	8.93%
PCC_7	4	2/5	1 1/4	2 2/3	-	2 1/4	21.04%
PCC_9	5	1/4	2/3	4/5	4/9	-	9.57%

Figure 7-34 PC_PCC_2 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	PCC_4	42.2%	1	19%
2	PCC_5	18.3%	3	43%
3	PCC_6	8.9%	5	47%
4	PCC_7	21.0%	2	49%
5	PCC_9	9.6%	4	46%

Figure 7-35 PC_PCC_2 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		IC_1	IC_2	IC_3	IC_4	IC_5	IC_6	normalized principal Eigenvector
		1	2	3	4	5	6	
IC_1	1	-	1 5/7	1	1 3/5	1 1/3	2 4/5	22.28%
IC_2	2	4/7	-	7/9	1 1/2	4/7	2 7/8	15.39%
IC_3	3	1	1 2/7	-	3 1/6	1	3 1/2	23.47%
IC_4	4	5/8	2/3	1/3	-	1/3	2	10.32%
IC_5	5	3/4	1 3/4	1	2 3/4	-	2 3/7	21.86%
IC_6	6	1/3	1/3	2/7	1/2	2/5	-	6.69%

Figure 7-36 PC_IC_1 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	IC_1	22.3%	2	48%
2	IC_2	15.4%	4	40%
3	IC_3	23.5%	1	48%
4	IC_4	10.3%	5	43%
5	IC_5	21.9%	3	26%
6	IC_6	6.7%	6	26%

Figure 7-37 PC_IC_1 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		IC_8	IC_9	IC_10	normalized principal Eigenvector
		1	2	3	
IC_8	1	-	1/4	2/7	11.26%
IC_9	2	4 1/4	-	2	55.77%
IC_10	3	3 2/5	1/2	-	32.97%

Figure 7-38 PC_IC_2 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	IC_8	11.3%	3	38%
2	IC_9	55.8%	1	31%
3	IC_10	33.0%	2	41%

Figure 7-39 PC_IC_2 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		IC_7	IC_11	IC_12	normalized principal Eigenvector
		1	2	3	
IC_7	1	-	1	1/3	20.31%
IC_11	2	1	-	1/3	20.81%
IC_12	3	3	2 3/4	-	58.88%

Figure 7-40 PC_IC_3 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	IC_7	20.3%	3	30%
2	IC_11	20.8%	2	49%
3	IC_12	58.9%	1	21%

Figure 7-41 PC_IC_3 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		EC_8	EC_11	EC_13	EC_17	EC_18	normalized principal Eigenvector
		1	2	3	4	5	
EC_8	1	-	1 1/2	3	1 1/2	1 3/5	29.78%
EC_11	2	2/3	-	1 1/2	1 2/5	1 3/5	22.14%
EC_13	3	1/3	2/3	-	1/3	3/5	9.87%
EC_17	4	2/3	5/7	3 1/5	-	2	23.46%
EC_18	5	5/8	5/8	1 2/3	1/2	-	14.74%

Figure 7-42 PC_EC_1 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	EC_8	29.8%	1	41%
2	EC_11	22.1%	3	42%
3	EC_13	9.9%	5	49%
4	EC_17	23.5%	2	49%
5	EC_18	14.7%	4	25%

Figure 7-43 PC_EC_1 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		EC_6 1	EC_7 2	EC_10 3	EC_12 4	normalized principal Eigenvector
EC_6	1	-	6 1/9	8 1/9	4 1/3	66.07%
EC_7	2	1/6	-	1	1	11.10%
EC_10	3	1/8	1	-	4/7	9.01%
EC_12	4	1/4	1	1 5/7	-	13.82%

Figure 7-44 PC_EC_2 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	EC_6	66.1%	1	3%
2	EC_7	11.1%	3	9%
3	EC_10	9.0%	4	22%
4	EC_12	13.8%	2	17%

Figure 7-45 PC_EC_2 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		EC_14 1	EC_15 2	EC_16 3	normalized principal Eigenvector
EC_14	1	-	1/6	1/4	8.62%
EC_15	2	6 3/8	-	1 1/3	52.79%
EC_16	3	4 1/3	3/4	-	38.59%

Figure 7-46 PC_EC_3 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	EC_14	8.6%	3	15%
2	EC_15	52.8%	1	30%
3	EC_16	38.6%	2	40%

Figure 7-47 PC_EC_3 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		IMC_1 1	IMC_2 2	IMC_3 3	IMC_4 4	IMC_5 5	normalized principal Eigenvector
IMC_1	1	-	2 5/8	1 1/7	2/7	3 2/5	19.87%
IMC_2	2	3/8	-	1/3	1/5	1	7.26%
IMC_3	3	7/8	3 1/4	-	4/9	2 2/7	19.35%
IMC_4	4	3 1/3	5 3/7	2 1/4	-	4 8/9	45.90%
IMC_5	5	2/7	1	4/9	1/5	-	7.61%

Figure 7-48 PC_IMC_1 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	IMC_1	19.9%	2	45%
2	IMC_2	7.3%	5	46%
3	IMC_3	19.4%	3	22%
4	IMC_4	45.9%	1	21%
5	IMC_5	7.6%	4	20%

Figure 7-49 PC_IMC_1 weights, ranking and coefficient of variation (Delphi round 2)

Matrix

		IMC_6 1	IMC_7 2	IMC_8 3	IMC_9 4	normalized principal Eigenvector
IMC_6	1	-	1 1/7	2	3 2/5	36.88%
IMC_7	2	7/8	-	2 1/4	3 1/6	35.13%
IMC_8	3	1/2	4/9	-	1 2/9	16.31%
IMC_9	4	2/7	1/3	4/5	-	11.68%

Figure 7-50 PC_IMC_2 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	IMC_6	36.9%	1	41%
2	IMC_7	35.1%	2	33%
3	IMC_8	16.3%	3	49%
4	IMC_9	11.7%	4	44%

Figure 7-51 PC_IMC_2 weights, ranking and coefficient of variation (Delphi round 2)

Matrix		CNT_3 1	CNT_6 2	CNT_7 3	normalized principal Eigenvector
CNT_3	1	-	1/6	1/4	8.99%
CNT_6	2	6	-	1 2/5	53.14%
CNT_7	3	4 1/5	5/7	-	37.87%

Figure 7-52 PC_CNT_1 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	CNT_3	9.0%	3	24%
2	CNT_6	53.1%	1	31%
3	CNT_7	37.9%	2	47%

Figure 7-53 PC_CNT_1 weights, ranking and coefficient of variation (Delphi round 2)

Matrix		CNT_1 1	CNT_2 2	CNT_4 3	CNT_5 4	CNT_8 5	normalized principal Eigenvector
CNT_1	1	-	1/2	1 3/5	1 1/7	1 3/4	20.82%
CNT_2	2	1 6/7	-	3	1	1 4/5	28.57%
CNT_4	3	5/8	1/3	-	2/5	3/8	9.27%
CNT_5	4	7/8	1	2 3/5	-	2 3/5	26.34%
CNT_8	5	4/7	5/9	2 3/5	2/5	-	15.00%

Figure 7-54 PC_CNT_2 AHP matrix (Delphi round 2)

	Criterion	Weights	Rk	CV
1	CNT_1	20.8%	3	30%
2	CNT_2	28.6%	1	36%
3	CNT_4	9.3%	5	49%
4	CNT_5	26.3%	2	24%
5	CNT_8	15.0%	4	49%

Figure 7-55 PC_CNT_2 weights, ranking and coefficient of variation (Delphi round 2)

The consensus was not the only improvement in the second round. The consistency ratio of the participants' provided responses were also enhanced to a more acceptable level.

Table 7-9 shows the calculated consistency ratios in the second and clearly previews that all the ratios are either equal to or less than 10%. These values indicate that all the responses collected in the second round are consistent, valid and should be accounted for when calculating the aggregated weights of the compared elements.

Table 7-9 Consistency ratio of the participants' responses (Delphi round 2)

	Participants							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
PC_PCC_1	9.00%	9.00%	8.00%	8.00%	9.00%	10.00%	10.00%	8.00%
PC_PCC_2	4.00%	3.00%	6.00%	6.00%	6.00%	3.00%	7.00%	3.00%
PC_IC_1	9.00%	10.00%	6.00%	9.00%	8.00%	7.00%	9.00%	9.00%
PC_IC_2	4.00%	7.00%	0.00%	7.00%	0.00%	0.00%	7.00%	7.00%
PC_IC_3	3.00%	4.00%	0.00%	3.00%	0.00%	0.00%	0.00%	0.00%
PC_EC_1	7.00%	5.00%	8.00%	9.00%	8.00%	6.00%	8.00%	10.00%
PC_EC_2	5.00%	2.00%	1.00%	6.00%	9.00%	2.00%	5.00%	2.00%
PC_EC_3	3.00%	1.00%	1.00%	7.00%	7.00%	0.00%	7.00%	7.00%
PC_IMC_1	7.00%	4.00%	5.00%	8.00%	6.00%	6.00%	5.00%	7.00%
PC_IMC_2	5.00%	9.00%	1.00%	8.00%	3.00%	1.00%	5.00%	6.00%
PC_CNT_1	7.00%	7.00%	1.00%	3.00%	7.00%	4.00%	7.00%	1.00%
PC_CNT_2	5.00%	4.00%	7.00%	8.00%	6.00%	5.00%	8.00%	9.00%
Mean	**5.67%**	**5.42%**	**3.67%**	**6.83%**	**5.75%**	**3.67%**	**6.50%**	**5.75%**

Table 7-10 shows the margin of improvement in the mean consistency ratios of each respondent when comparing the first round with the second round. It can be confirmed that the consistency ratios for all the participants has been refined in the second round.

For instance, participant 2 had an mean CR of 20.3% in round 1 while the same participant had a CR of 5.4% in the second round. This shows that the participants provided approximately four times more consistent answers in the second round when compared with the first round.

Table 7-10 Consistency ratio of the participants' responses (comparison between Delphi round 1 & round 2)

	Participants							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Round 1	9.50%	20.30%	14.50%	28.90%	18.80%	21.80%	26.20%	17.30%
Round 2	5.70%	5.40%	3.70%	6.80%	5.80%	3.70%	6.50%	5.80%

Based on the degree of consensus and consistency ratios concluded in this round, it can be deemed that no more rounds are necessary. The next section will discuss how the weights of the change management practices and tools will contribute to the creation of the CMCMM model.

7.3 CMCMM COMPONENTS

This section previews the method through which the initial version of the Change Management Capability Maturity Model (CMCMM) was created. The initial version was later on updated and verified for its practicality and validity to be used by contractors in Kuwait.

All the capability maturity models are composed of two components which are improvement criteria and improvement representation (Wendler, 2012). Improvement criteria represents the requirements of achieving a specific level of growth and capability while improvement representation refers to the levels used to indicate maturity or capability in the models.

As previously discussed in Chapter 4, the CMMI is a suitable model to inspire the creation of CMCMM. The usage of the CMMI as a guiding model to develop further models in the change management domain is quite common in the literature. Sun *et al.* (2009) mentioned that the model was developed on the same basis of the CMMI. Similarly, the CMCML developed by Arowosegbe & Mohamed (2015) utilises the same structure of the CMMI model. To avoid terminology confusions, the terminologies used in CMCMM were identical to the ones used in the CMMI including specific goals (SG's), specific practices (SP's), generic goals (GG's) and generic practices (GP's) with change management being the main process area.

7.3.1 CMCMM Improvement Criteria

The improvement criteria shows the requirements for each stage of growth and mainly includes the SG's, SP's, GG's and GP's. The specific practices were generated and refined by different research methods including a deep literature review, an interview and a questionnaire survey thus fitting the domain of change management and to be in complete alignment with the Kuwaiti construction industry parameters and constraints. This approach of concluding the specific practices was used by Mughrabi & Jaeger (2017), Arowosegbe & Mohamed (2015) and Sun *et al.* (2009) in addition to many other researchers that depends on collecting and validating real practices used in a specific domain and use it in creating a capability maturity model. Since a specific goal is achieved when all the underlying practices are complete and used in the organisation (CP Team, 2011) the principal components were considered as the specific goals in CMCMM as achieving competence in the underlying practices would resemble the completeness of the principal component itself.

A distinct approach was earlier used in order to connect the domain capability with the change management stages in CMCMM. The specific practices within the same change management stage (promoting a balanced change environment, identifying change, evaluating change, implementing and monitoring change and continuously improving) were grouped to different specific goals. When reviewing the literature, no other models were dive pled on the basis of distinguishing the different stages of a management process. This unique approach provides the organisation with a bird's eye view in order to indicate the stages of the change management were weaknesses in capability exist. For instance, the bigger image is more clear and improvement strategy would be more effective if the organisation would recognise that it is fully capable of identifying change yet it lacks competence in evaluating it.

As CMCMM is a domain specific model that uses the continuous improvement representation, the same generic goals and practices featured in the CMMI are applicable. The generic goals and practices are featured in the CMMI and are mainly used for the achievement of standardisation and Institutionalisation of a certain domain or all the domains collectively (depending on the improvement representation). This approach was adopted by Mughrabi & Jaeger (2017) where the research shows that the generic goals and practices were used directly from the CMMI while the specific practices were tailored to fit the required domain. The generic goals are explained in the CMMI and includes GG1 which is concerned with achieving all the specific goals, GG2 is focused on achieving organisational standardisation for the process and finally GG3 emphasises the tailoring of the standardised process and continuously improving it based on collected data of performance and process output. These goals are accomplished through conducting the underlying generic practices. The generic practices are described with orientation towards each domain mentioned in the CMMI in order to preview how these practices could be applied to assess the capability level of the domain itself. For instance, GP 2.8 requires monitoring and controlling the process where the CMMI suggests how this practice could be used in the risk management domain specifically.

The created CMCMM model includes 12 specific goals and 52 specific practices as shown in Appendix J. Table 7-11 provides an overview on how the specific goals and practices are correlated with the change management stages. Until this point of the research, the codes used for the change management practices and tools were the same ones used in the questionnaire data analysis in the SPSS and featured in Appendix F. Since the model refers to these practices and tools as SP's, it is necessary to replace the old codes with new ones that would be in alignment with the conventions featured in the CMMI (i.e. SP1.1, SP1.2, …etc). The same situation applies to the PC's concluded which will be referred to as the SG's.

Table 7-11 Change management stages connection specific goals and practices overview

Change Management Stage	Specific Goal	Specific Practice
Promoting a balanced change culture	**SG1**	**SP1.1**
		SP1.2
		SP1.3
		SP1.4
		SP1.5
		SP1.6
	SG2	**SP2.1**
		SP2.2
		SP2.3
		SP2.4
		SP2.5
Identifying Change	**SG3**	**SP3.1**
		SP3.2
		SP3.3
		SP3.4
		SP3.5
		SP3.6
	SG4	**SP4.1**
		SP4.2
		SP4.3
	SG5	**SP5.1**
		SP5.2
		SP5.3
Evaluating Change	**SG6**	**SP6.1**
		SP6.2
		SP6.3
		SP6.4
		SP6.5
	SG7	**SP7.1**
		SP7.2

		SP7.3
		SP7.4
	SG8	SP8.1
		SP8.2
		SP8.3
Implementing and Monitoring Change	SG9	SP9.1
		SP9.2
		SP9.3
		SP9.4
		SP9.5
	SG10	SP10.1
		SP10.2
		SP10.3
		SP10.4
Continuos Improvement	SG11	SP11.1
		SP11.2
		SP11.3
	SG12	SP12.1
		SP12.2
		SP12.3
		SP12.4
		SP12.5

7.3.2 CMCMM Improvement Representation

The improvement representation in CMCMM depends completely on choosing either the continuous or staged improvement representation. The continuous improvement representation used in the CMMI was used and allow CMCMM to focus on a specific domain which in this model is exclusively change management rather than focusing on the overall organisational performance. This choice is synonymous to the utilisation of Capability Levels (CL's) rather than Maturity Levels (ML's) that are used in the staged representation.

The determination of the capability levels for any domain was extensively explained and reviewed in chapter 4 as it is used in the CMMI. The CMCMM model follows the same route to determining the capability levels in addition to enhancing the accuracy of concluding the change management capability levels. The pivotal difference in both improvement representations is the accuracy in determining the progress of achieving competence in the domain.

The CMMI requires all the specific goals to be completed in order to consider the domain capability at CL1. If any of these specific goals were not achieved, the domain would be considered at CL0. The organisation that is having the specific domain appraised would require an accurate report stating the main trigger of achieving this particular capability level in order to understand which goals are missing. If a report would be generated, the organisation would realise that the specific goals were either achieved or not achieved. Achieving a specific goals means that all the underlying practice were conducted while not achieving means that either one or all the underlying practice were missing (CP Team, 2011). This indicates that the critical unit of domain competence indication is delivered in either black or white with no shades of gray in the middle (binary). For instance, a company could have completed 14 out of 15 specific practices that are required to achieve a specific goal yet get the indication that the specific goal is not achieved. Therefore, the progress of achieving the goal should be calculated. There are no weightings for the specific practices this thus users assume that all the underlying specific practices carry the same weight in the calculation and contributes equally to the success of the domain which is simply not true. Thus going back to the same example, in case a company could have completed 14 out of 15 specific practices, the specific goal would be around 93% complete. A percentage that does not resemble the varying importance of each specific practice's contribution towards achieving the specific goal. Each specific practice should contribute to the score on the basis of its significance. Therefore, if a calculation is to be done to determine the percentage of achievement per specific goal, the result would be inaccurate.

This is where CMCMM is different and enhanced when compared to the CMMI. The specific goals are achieved through by conducting the weighted specific practices thus indicating the actual state of progress for the change management domain. The weights of the specific practices were concluded from the AHP process and were based on comparing elements within the same grouping (concluded from PCA) which will in return increase the accuracy of capability measurement based on the significance of each change management specific practices.

As an example in CMCMM, SG10 depends on SP10.1, SP10.2, SP10.3 and SP10.4 and requires these practices to be conducted in order for the goal to be achieved. In case SP10.1 was the only incomplete practice and depending the previously established practices relative weights, SG10 would be 63.1% achieved only. If the approach of CMMI (no assigned weights) was to be used, SG10 would be 75% achieved which is overestimating the actual progress towards achieving the specific goal and in this case, creating the illusion of overachieving the goal.

Obviously, after exceeding CL1 and when the specific goals and practices are not the determinant factors for capability levels, both models use the exact same method in the continuous representation as it depends on the generic goals and practices that are typical in both the CMMI and the CMCMM model in order to establish an standardised and continuously improvement process. The connection between the capability levels, generic goals and specific goals in also clarified in Appendix J.

7.2.3 CMCMM Appraisal cycle

A proper appraisal cycle properly evaluates the best practices undertaken in the organisation and the corresponding capabilities (PMI, 2003). Similar to the CMMI, the CMCMM uses the SCAMPI appraisal phases that are defined in the Appraisal Requirements for CMMI (ARC). These phases include the planning and preparation for appraisal, conduct appraisals and reporting results (CMMI Product Team, 2010). The ARC provides the user with three different appraisal options known as SCAMPI A, SCAMPI B and SCAMPI C which were previously explored, reviewed and compared in chapter 4.

Given the objective of this research, SCAMPI C is considered the most suitable and sufficient option as an appraisal method as it is a systematic and sufficiently detailed to conduct the appraisal. First, the appraisal through case studies were conducted later on by the author only as the magnitude of work does not require an entire appraisal team. The appraisal team is one of the requirements in SCAMPI A and B. Next, SCAMPI C does not require the person conducting the appraisal to be certified by Software Engineering Institute (SEI) to the contrary of SCAMPI A.

This requirement is connected to awarding a certification for organisations properly adopting the CMMI. As this is a research that is conducted to create a model and conducting the case studies later on is part of that, being certified is not required. SCAMPI C only requires that the appraiser would be accustomed to the model and to the appraisal plan rather than being certified. Another main reason for choosing SCAMPI C is that the evidence collected to prove competence does not need to be verified by different sources unlike SCAMPI A and B. On this basis, the cycle used in CMCMM resembles the requirements of SCAMPI C for conducting the domain appraisal which also covers the appraisal cycle requirements endorsed by Paulk *et al.* (1991).

The planning phase includes contacting the party(s) that will be involved in the appraisal within the organisation. A suitable appointment should be agreed upon to avoid any rapid responses pushed by work load of the interviewee and gaining as accurate information as possible. Prior to the appointment, the appraiser should provide a briefing about CMCMM and the main objectives of the model and highlighting how beneficial it can be for improving the change management capability within the organisation. The method of appraisal is also shared in order to estimate a suitable timing for the interviewing process.

The next phase which is conducting the appraisal itself starts with confirming the objective of the appraisal and describing the bigger image of enhancing the change management capability through finding the gaps in the currently established change management process. Next, an appraisal checklist should be used through face-to-face structured interviews in order to perceive which practices are done or not within the organisation.

This tool should mainly include all the specific practices and generic practices that are included in the CMCMM model and featured in Appendix J and can be used as a checklist. This approach simply and directly recognises if the practice is done or not in addition to saving as much time as possible to ensure proper participation and avoid rushing by the interviewee. The data were collected by the appraiser and evidence of criteria conformance can be collected when available and accessible.

The last phase of the appraisal is initiated with the compilation of the collected data in order to conclude the change management capability level of the appraised organisation. When the capability levels are calculated, a report was formed and sent to the organisation showing the strength and weaknesses of their change management process in the current state. The report would follow the same format of the CMCMM model shown in Appendix J to provide the organisation with a sense of continuity rather than spending time deciphering the appraisal findings. The report also includes could also include comments from the appraiser based on recognised patterns such as recognising that the main gap in change management practice is related to a specific phase. For instance, the organisation is scoring low in a specific change management stage and is doing well in other.

The appraiser can also recommend an action plan based on the current weaknesses and practice gaps in order to improve the capability levels of the change management process. This would be the last step of the appraisal cycle of CMCMM. Factors such as frequency of conducting the appraisal and follow through with the action plan should be determined based on the organisational commitment for improving and sponsoring a better change management process.

Following the creation of the CMCMM, the model should be tested to confirm its capacity to indicate and potentially improve the project change management process of contractors in Kuwait. Prior to actually testing the models usage through case studies, an expert review will take place to ensure the validity of the model and its ability to achieve its purpose. The entire verification process was handled in the following chapter of this dissertation.

7.4 SUMMARY

Following the results concluded in Chapter 6, the principal component analysis (PCA) technique was used as a dimension reduction technique of the successful change management practices and tools. Based on the analysis results, twelve different dimensions were concluded to fully represent these practices and tools. After the dimension reduction process, the the Analytic Hierarchy Process (AHP) process was used to compare between the change management practices and tools. An expert panel were consulted for the purpose of assigning weights to the criteria within twelve different matrices to reflect their relative significance.

The Delphi technique was used in conjunction with the AHP process to assure that consensus is reached to an acceptable degree between the experts in addition to focusing on the individual consistency ratio of each respondent reached an acceptable reliability level. This chapter also featured the creation of the initial version of the Change Management Capability Maturity Model (CMCMM) based on the conducted literature review, questionnaire survey and AHP results. The weights concluded from the AHP process were assigned to the specific practices of each change management stage. The created CMCMM model included fifty-two specific practices that are grouped under twelve specific goals and employing the SCAMPI appraisal phases for evaluating the capability of the contractor to manage change.

CHAPTER 8 - MODEL APPLICATION AND VERIFICATION

8.1 INTRODUCTION

Literature shows that capability maturity models developed is currently inclined to follow a structured approach of development and validation in order to obtain quality and value adding results (Storbjerg *et al.*, 2016). In the previous chapter, the change management capability maturity model (CMCMM) was established and its components created on the basis of conducting a successful change management process by contractors in Kuwait. In this chapter, the quality and trustworthiness of CMCMM was tested through applying it to the real world scenario and observing the performance and validity of and value added by the model.

Since this research aims to produce a design-oriented model, properly validating the models is vital for the construction of CMCMM. The model application and verification followed the two-stage framework developed by Salah *et al.* (2014). Based on the previously conducted literature review, this framework proved to be both extensive and rigourous to ensure that the model is optimised to the highest level of validity and fitness for purpose. This framework starts with an expert review which followed by conducting a case studies. These two stages are defined as domain experts evaluation and practical setting evaluation.

8.2 DOMAIN EXPERT EVALUATION

The first step of evaluating a capability maturity model is having it reviewed by matter experts in order to gain a critical perspective on the validity of the developed model (Fulford & Standing, 2014). These experts should have knowledge in the subject of project change management to be capable of contributing positively to the verification process. Such experts should have routes either in the industry or in academia staff who are involved in research concerned with the construction project management domain. This combination of both sectors should collectively provide constructive criticism and feedback about the potential practicality, reliability and fitness for use of CMCMM. As a result, the optimised version of CMCMM was more capable of indicating the ability of a contractor in Kuwait to manage project change.

De Bruin *et al.* (2005) points out that the model construct and evaluation instrument should be verified within the domain expert review. This includes the review of the model criteria itself, the performance scale and the assessment procedure. Maier *et al.* (2012) also followed the same method to ensure the validity of the developed maturity grids was verified. On the same basis, Storbjerg *et al.* (2016) found the approach pointed out by Maier *et al.* (2012) to be the most suitable approach and built on similar ground to the approach introduced by De Bruin *et al.* (2005) thus used it to validate the model thus it was used to change management maturity grid. Salah *et al.* (2014) also supported the same approach of model validation through corroborating the necessity of reviewing the same elements as step of confirming the validity of the developed model prior application in a real life setting. Following the same route of these studies, the domain expert evaluation of CMCMM should be concerned with Optimising the improvement criteria, improvement representation and appraisal cycle to guarantee a high quality model that provides genuine outcomes.

8.2.1 Data collection

Prior to conducting the domain expert evaluation, the model criteria should be verified through referencing sources in the literature showing the origination of the criteria (De Bruin *et al.*, 2005). This is important to ensure that the criteria is covering the required scope both rigorously and accurately. This step has already been done in this research through sourcing the change management specific practices to either the conducted literature review or from the coding analysis of the preliminary interviews. The practices concluded from these two sources were already validated (while other practices/tools were omitted) by industry professionals who are currently working in the Kuwaiti construction industry through a questionnaire survey. Therefore, the model criteria should be robust and should be displayed to the experts for review.

When reviewing the literature, there are no specific set of questions that can be presented to the domain experts. Salah *et al.* (2014) confirmed that the literature does not include a developed guidelines for the questions to be asked in the expert review for a capability maturity model. Therefore, Salah *et al.* (2014) developed and proposed a set of questions that would allow the reviewers to indicate the correctness of the model components on a five-point Likert scale. Storbjerg *et al.* (2016) also used a questionnaire survey that included the five-point Likert scale to indicate the significance of each criteria in the model and maturity grid's quality as a whole. The experts in both studies were requested to comment on any component of the model if required. The main difference between both studies is that the experts in the study conducted by Storbjerg *et al.* (2016) were requested to assess the importance of each practice to the domain while the approach followed by Salah *et al.* (2014) was less specific. For instance, Salah *et al.* (2014) would requested that the respondents would indicate whether they agree or disagree with relevance, comprehensiveness, mutual exclusion and accuracy of the practices in general rather than rating the practices one by one. Since the practices were already evaluated by 112 industry professionals prior to being used in the CMCMM model, it is rather redundant to re-evaluate these same practices individually. It is more important to take the same approach used by Salah *et al.* (2014) and ask questions in a collective holistic to provide a wider view on the model's value.

On this basis, the questions provided by both studies were optimised to fit the domain, terminologies and research objective and were compiled into a questionnaire survey. Beecham *et al.* (2003) used a questionnaire survey to validate the criteria of a developed capability maturity model. The questionnaire was delivered face to face in order to clarify any part of the instrument or the model that may be unclear in the eyes of the experts thus ensuring the validity and reliability of the study. It seemed preferable to use individual and isolated questionnaire surveys for several reasons that may negatively influence the outcome including the avoidance of group pressure and conflicts (Delbecq *et al.*, 1975). More importantly and since the participants may be working in competitive organisations, granting anonymity and privacy would ensure that the experts can fully express their views without feeling exposed to the competition thus elevating the degree of value of the collected data (Delbecq *et al.*, 1975).

Additionally and in case of industry professionals, the author is more capable of ensuring that the experts understand the purpose and functions of CMCMM as the model will be seen as ambiguous and vague these experts if no explanation was provided. And another very critical aspect is that some participants may need assistance in expressing their opinions in the English language as some experts may not be able to communicate sufficiently in their non-native language. Translating the practices to the Arabic language could also be beneficial to guarantee an adequate level of understanding for both the questionnaire and the model components.

Appendix K shows the questionnaire survey instrument that the experts were requested to answer. The first part of the survey was focused on the demographics of the experts. The second, third and fourth part were concerned with the model improvement criteria, the model improvement representation and the model's appraisal cycle respectively. Each section allowed the expert to add any comments or suggestions either to the aspects studied or the model in general to allow for additional constructive and innovative comments leading to improving the current model.

The data collection started with scheduling a meeting with the experts and providing them with the questionnaire face to face. A general briefing about the research topic, capability maturity models and the objective of the model was discussed with the experts. Some of these experts seemed to pick up on the topic easily and was ready to review the model and respond to the questionnaire while others asked few questions to understand the aim of the developed model and how it will work in real practice. After ensuring that an adequate level of understanding was attained, the experts were requested to answer the questions featured in the survey. The author did ask for clarifications on the comments section and took the liberty of translating some phrases as well to ensure proper understanding of the survey instrument. The evaluation process ranged between one hour to one and half hours (including the time spent on the explanation at the beginning).

8.2.2 Experts Profile

The process of choosing the domain experts was concerned with determining suitable candidates who may be qualify and would provide value adding feedback. Even though several studies exclusively consulted with researchers or academics with knowledge in the management domains in the expert review stage, it was preferred include both insightful academics and industry professionals in this research. Industry experts can provide a useful insight when it comes to reviewing the capability maturity model (Zeb *et al.*, 2013). The selection criteria for the academics considered the level of experience in teaching and research, educational background in the construction project management discipline and industry experience. The selection criteria for the industry professionals required a minimum of 10 years of experience in the construction industry and the stipulation of currently being in a managerial position within a contracting company.

This criteria ensures that the participants have adequate knowledge and can positively contribute to this research as domain experts. The participants in this stage were not originally involved in the previous model development phases (Salah *et al.*, 2014). A pivotal detail that would assure that a fresh perspective and constructive criticism will be gained.

After searching and contacting potential candidate, the survey was eventually filled by ten experts who were not involved in any previous stage of the research. Six participants were highly experienced practitioners with a current managerial position and currently working the Kuwaiti construction industry. The other four participants were academics working in Kuwait and actively involved in construction project management related research. One of these academics was involved in research related to developing and testing a capability maturity model as well.

Table 8-1 previews the profile of the experts requested to review the CMCMM model. Some candidates has combined industry and teaching/research experience while most of the candidates have experience in one of the sectors only. Any industry experience recorded for the academics was in the past as universities in Kuwait prohibit any additional work in the contract of full-time faculty members. In other words, lecturers cannot teach and work in the industry at the same time in Kuwait. In one case, a construction manager illustrated that he used to work as a teaching assistant at the beginning of his career.

Table 8-1 Domain Experts Profile

Expert No.	**Current Position**	**Experience (Teaching & Research)**	**Experience (Industry)**
1	Project Manager	None	23 years
2	Construction Manager	1 years	16 years
3	Senior Project Manager	None	27 years
4	Project Manager	None	18 years
5	Project Manager	None	21 years
6	Project Director	None	36 years
7	Assistant Professor	11 years	3 years
8	Assistant Professor	9 years	7 years

Expert No.	Current Position	Experience (Teaching & Research)	Experience (Industry)
9	Associate Professor	22 years	5 years
10	Associate Professor	26 year	9 years

8.2.3 Analysis of Results

The results from the questionnaire survey were compiled in an excel spread sheet for analysis and reflection. This section discusses the results as featured in the survey itself starting with improvement criteria, improvement representation, appraisal cycle then explore the comments/suggestions provided by the domain experts. Table 8-2 shows the data collected from the experts where the value (5) indicating “strongly agree” and the value (1) indicating “strongly disagree” to the given statements. The mean value and standard deviation of the values were also calculated and closely observed to get a sense of the overall perception and consensus. The highlighted cells indicates a relatively low rating values and requires additional attention as a step of understanding the existing weaknesses in the model and improving it accordingly. The overall mean rating was “4” which demonstrates a healthy level of appreciation by the domain experts of the model’s content, worthiness and fitness for purpose.

The first part of the evaluation was fixated on the CMCMM improvement criteria. Evidently, the experts appreciated how comprehensive and relevant the model criteria is to the domain of change management and the Kuwaiti construction industry. Moreover, the experts highly rated the connection between the criteria and capability levels in addition to the agreeing that these criteria can positively impact the organisational ability to conduct change management. Nonetheless, the experts also realised that some of the criteria were overlapping and unclear to the potential model user.

When it came to the improvement representation of the model, it was clear that their various weak spots in this area. Other than agreeing that the model’s improvement representation being sufficient to represent the different levels of capabilities in conducting the process, the participants were generally inclined to disagreeing with the value added from this model component. The experts responded that the improvement representation lacks clarity, proper description in addition to some experts not specifically perceiving how the models' representation will potentially support the project change management improvement in the organisation.

Table 8-2 Ratings from the domain experts

Expert No.	Survey Part II					Survey Part III				Survey Part IV			
	A	B	C	D	E	A	B	C	D	A	B	C	D
1	4	3	5	5	3	3	4	2	4	5	2	5	5
2	5	4	4	5	2	4	4	2	2	5	2	4	4
3	5	3	5	5	2	3	4	3	2	5	3	4	4
4	4	4	5	5	4	3	4	4	3	4	4	5	5
5	5	3	4	5	2	4	4	3	5	5	5	5	4
6	4	2	3	4	1	4	4	2	5	5	4	4	5
7	5	4	4	5	2	5	4	2	4	5	4	5	5
8	5	3	4	5	3	3	5	4	4	5	5	5	5
9	5	4	5	5	3	5	5	4	5	5	4	5	4
10	5	4	4	4	2	4	4	2	3	5	5	5	4
Mean	4.70	3.40	4.30	4.80	2.40	3.80	4.20	2.80	3.70	4.90	3.80	4.70	4.50
Std Dev.	0.48	0.70	0.67	0.42	0.84	0.79	0.42	0.92	1.16	0.32	1.14	0.48	0.53
CV	10.21%	20.59%	15.58%	8.75%	35.00%	20.79%	10.00%	32.86%	31.35%	6.53%	30.00%	10.21%	11.78%

The experts also evaluated the appraisal cycle and it was overall rated positively. The experts highly agreed that the appraisal cycle is clear to comprehend and that the appraisal tool is user friendly and would eventually support improvement in the change management domain within the organisation. Nevertheless, it is clear that some of the experts were not completely convinced in the degree of practicality offered by this cycle within an organisation. In other words the tool was generally appraised highly for its effectiveness and ease of use yet some of the experts criticised the cycle for its lack of practicality.

The coefficient of variation (CV) was also calculated for all the concluded values in order to find the level of consensus reached in all the responses. CV was calculated by dividing the standard deviation over the mean of each statement. CV ranged between 6.53% to 35% for all the elements which means that a high degree of agreement was indicated by the respondents as these values did not exceed the 50% limit that was specified by Dajani *et al.* (1979).

A good indication that the model was received equally and similarly by the different respondents. The experts agreed the most that appraisal cycle of the model was clear enough to implement in a contracting company. A sign that using the SCAMPI C appraisal method was a successful choice indeed and was welcomed by experts for its simplicity and practicality. Apparently, The respondents agreed the least on the clarity of the model criteria. Nonetheless, since the coefficient of variation was 35%, it was enough to conclude that there was a shared concern about the criteria clarity by the respondents even if it was to varying extent. This matter can be explored and analysed in more detail through the comments/suggestions provided by the experts.

Overall, indicating the degree of agreement on the statements using a scale introduced valuable feedback by the experts. Similarly, constructive comments came from the comments/suggestions section of the survey where the experts provided feedback that can truly take the model to the next level. These comments can be organised into five categories focused on the model criteria, representation, appraisal cycle and the overall usability and practicality of the model for usage in Kuwait as shown in table 8-3. Some of these suggestions were translated from the Arabic language to English by the author as some respondents had valuable input yet could not fully express their opinions in the English language.

Table 8-3 Comments and suggestions from the domain experts

Category	Comment/suggestion provided by the domain expert
Improvement criteria	The weights should be rounded up/down to avoid unneeded complexity.
	Add brief description to the complicated practices to show meaning.
	Elaborate more on the meanings of the generic goals and practices.
	Add description to confusing practices for better understanding.
	Specific and generic practices have many similar practices
	There is no need for using decimals in the weights. Simple clear numbers should be fine for this usage.
	Mention how change prediction works.
	Simpler language should be used for the criteria.
	If some criteria is not needed, can it be altered?
	Do not continue evaluating to the generic practices if specific practices were already missing to save time.
	Description of some practices should be provided to make sure that the model can be used the same way by different users.
	The generic practices need further simplification.
	Identical practices are mentioned in the specific practices and generic practices such as training and assigning a team to manage change.
	Provide description for practices like DSM and KBDSS.
Improvement representation	Visual aids should be used for indicating the overall progress of the specific goals based on scores (like a battery charger indicating red, yellow and green).
	Show summary of how many specific goals are completed and how many are still missing
	Why not use a spider diagram to summarise the progress in completing the specific goals?
	An example of how the process would be performed in different levels should be given as an example.
	The capability levels need more explanation.
	Again, simpler language would be better here.
	Is it possible to start from level 1 instead of level 0?

	What is the difference between the managed and defined process.
	The difference between CL2 and CL3 is not clear.
Appraisal cycle	Add a figure that shows how the appraisal works and share it with the stakeholders prior to conducting the appraisal.
	The appraisal should start with a brief introduction of how it was created and customised for Kuwait to increase confidence in the model.
	A brief introduction to change management should be shared before the assessment.
	For big companies, a team should be used for evaluation not only one auditor.
	In the appraisal tool, add an area for comments to improve the output report.
	The data should be collected from more than one source if no evidence will be collected to confirm genuine evaluation.
	The capability evaluation should be done through an external evaluator if possible to avoid bias and ensure accurate output.
	The evaluation tool and report should be connected to save time.
	Create a sheet that includes all the components of the model (like a tree)
	Provide a guide for using the model in the organisation
	Create a list that mentions all the model components
	The size of the project should influence the model usage. A set of guidelines should be created for that change.
	Using change management is currently partial where a lot of the important phases mentioned in the model are overlooked by contractors in Kuwait.
	Having a high ability in performing change management in Kuwait is absolutely essential for all contractors. Putting the additional effort of using this model will have a positive outcome to the contractors specially in complex projects.
	The terms used in the model maybe clear for academics with research experience in project management but unclear for industry people. The wording should be simplified if possible to get a user friendly model.

Overall Usability & Practicality	Variation orders is one of the major topics debated in Kuwait. It is because the consultant always perceives contractors to abuse variation orders to gain more profit in the project. This model will increase the overall transparency of the change cost estimate.
	What if the company wants to tailor the model criteria (add/ remove practices)? Are there any guidelines?
	The model is too futuristic for the local industry. For example BIM is successful but still rarely used in Kuwait. This means that the organisation willing to use the model will have to implement costly changes and updates which is a possible barrier to using this model.
	The size of the project should influence the model usage. A set of guidelines should be created for that change.
	Some contracting companies use the ISO standard for ensuring a systematic process. Such companies would be more welcoming to this model in comparison with other companies who adopts reactive and ineffective project management methods.
	The model criteria was created on what should be done in Kuwait rather than what is already used. Since a lot of money loss is from improperly managing project change, this model will contribute to improving the change management practices used in most contracting companies.

The first category of comments and suggestions were concentrated on the model improvement criteria. Most of these comments fixated on the need to provide a better description for some of the specific practices that are perceived as complicated such as change prediction, DSM and KBDSS.

The generic practices were also criticised for its vagueness and the need to explain these practices was emphasised. Using a clear description and clear simple language was highlighted by one of the experts as he mentioned that it is essential for the consistent usage of the model. Two experts mentioned that the specific practices weights should be rounded up or down to avoid the unnecessary usage of decimals as this will not affect the compared significance of the practices. Another issue that was pointed out by several experts is that there is some overlapping between the specific and generic practices. An example was given by one of the experts by questioning the need of having “ training” and “assigning a team to manage change” in both the specific and generic practices and describing this phenomenon as an unnecessary repetition of the same practices.

Other experts were speculating the possibility of using guidelines to tailor the model criteria when needed in the organisation through adding or removing practices based on the project's varying parameters.

Fewer comments and suggestions were provided for the improvement representation. Nevertheless, the comments in this section had a very clear pattern of emphasising the need to use simpler language to describe the capability levels used in the model. The distinction between terms such as "managed process" and "defined process" was challenging for some experts. Two experts were facing difficulties understanding the difference between CL2 and CL3. One expert suggested to avoid confusion, the capability levels should feature a clear example of how change would be managed at that particular level. The next pattern of comments and suggestions focused on the increasing need of using visual aid to ensure better understanding of the current situation and progress in handling project change. One expert suggested the usage of an indicator next to the specific goals the would preview the overall progress of performing the specific practices and based on their weights.

A battery health bar was suggested showing red, yellow and green depending on the achievement of the specific practices within the goal. Another expert suggested the usage of a spider diagram to summarise the overall progress amongst the specific goals. A third expert confirmed this need through endorsing the usage of a progress summary that would show which change management related practices are done and which are missing in the organisation. Other comments were questioning the flexibility of the representation to accommodate the different needs of the organisation. One expert was wondering if the organisation would be able to use the term "CL1" instead of "CL0" to indicate the first of the four capability levels.

Valuable comments and suggestions were also provided to fine-tune the appraisal cycle and its contents. First, several experts focused on the usage of figures to simplify the appraisal cycle and its requirements and for this figure to be shared with the relevant stakeholders prior to conducting the appraisal. This appraisal cycle summary should also be accompanied by a brief introduction about change management should be send be also sent to the relevant stakeholders. Describing the way the CMCMM model was created and customised for contractors in Kuwait should be mentioned prior to the evaluation to increase confidence in the model's rigour and potential value for the contracting company in addition to increasing confidence in the model and the overall willingness for seeing through its implementation. Other experts focused on the evaluation process itself. An expert pointed out that the evaluation should be done by an external validator if possible to avoid bias and secure a correct output.

Another expert suggested that the data should be collected from a number of personnel to ensure the correctness of the answers given and pointed out that this is one of the best routes to gather authentic data in case evidences were not collected. This data should be collected by using a team of appraisers to ensure proper productivity in the evaluation process in the case of big companies rather than having only one appraiser perform such an overwhelming task. Another expert suggested adding a comments section in the appraisal checklist to ensure that the report output would be as value adding as possible and would be including tailored suggestions for the organisation. To save time and ensure a more efficient evaluation process, an expert suggested that the appraisal checklist should be connected to the output report. This suggestion would further decrease the time required by the appraiser to generate a report through the usage of a common and regularly available software. As an additional step for saving time, an expert advise that the evaluation should stop if some specific practices are missing since CL1 will not be achieved anyway. It would be pointless to continue the evaluation knowing that only CL0 will be attained in the organisation.

The experts provided feedback concerning the overall usability and practicality of the model. These comments provided an excellent image of the model's quality and fitness for purpose. Two experts recommended summarising all the model components in a sheet that shows how the model components interact together. That would be in addition to an expert recommending the usage of a handbook to guide a new user through understanding the model's components and navigating the entire appraisal process. Additionally, one expert pointed out that the terms used in the model maybe clear for academics with research experience in project management but would seem sophisticated for industry people thus should be simplified. These suggestions if implemented collectively, would ensure a more user-friendly model and reduce any required briefing and evaluation time.

The experts appraised the potential value added to the contracting companies using CMCMM to improve their management capabilities. They pointed out that change is currently managed partially without considering all the necessary phases for adequate management. And also, having a high performance in change management is essential specially in Kuwait as project variations are specifically one of the main debatable issues in the local construction industry.

The main reason is that consultants consistently recognise that contractors take advantage of variations to make unjustifiable profit through abusing such opportunities. Enhancing the proficiency and transparency of the change management process would be positively influence trust in the contractor. Another major value adding feature of the model as pointed out by one expert is that the model was forged from the practices that would be successful in managing change by contractors in Kuwait. It is a good approach rather than simply testing what is currently used and not working to a suitable level. This is evident in the consistent money loss due to improper change management.

The experts finally shared some concerns regarding the practicality and the adaptability of the model in the real life setting. The first concern is that some companies already use systematic processes to manage their projects (such as using ISO9001 for quality management) and would be ready to adopt such a model as it would not represent a complete overhaul to their current methodology of managing projects.

Nonetheless, other companies are more reactive and use project management on an Ad-hoc basis therefore the model would be challenged throughout the company and its implementation would be resisted. That would be from the perspective that a lot of effort, time and cost will be associated with such a model. Another expert criticised what he described as the "futuristic" quality of the model and claimed that the requirement to introduce new practices such as using BIM in the organisation may hinder the utilisation of CMCMM in improving change management. Such practices will imply the dedication of additional resources for its implementation.

8.2.4 CMCMM Enhancements

It is clear from the domain experts' input that there is a big room for improvement in the model. The provided constructive criticism was used as a foundation for refining the quality and build of the model to better suit its purpose and potentially add more value to the organisation utilising it to improve its change management capability. A summary of the upgrades implemented in the model in order to accommodate the comments and suggestions provided by experts are shown as following:

- The CMCMM User Guide was developed to describe in detail and clarify the model criteria, the model improvement representation, the appraisal process, guidelines and tools.
- The weights of the specific practices were rounded up/down for simplicity.
- Charts and visual aids were created to indicate improvement progress.
- The appraisal checklist tool was linked to the appraisal report to facilitate an automated and efficient appraisal process.

Appendix L shows The CMCMM User Guide with all the upgrades mentioned above. The guide also features a hypothetical scenario of conducting the appraisal process to test the change management capability within the organisation. The guide would be very effective when used in conjunction with prior knowledge and experience in using capability maturity models. The guide also shows the appraisal checklist and the appraisal report.

An automated connection was established between the checklist and report in order to facilitate an efficient appraisal process. The report calculates the change management capability level, indicate which practices and goals were fulfilled and which were incomplete, calculate the completion percentage of the specific goals based on the weight of the completed specific practices and show an illustrative chart of the specific goals completion profile. Any additional comments and findings mentioned in the appraisal checklist will be automatically transferred to the appraisal report. In case of no prior knowledge, the example mentioned at the end of the guide should be sufficient to give a clear idea of the model components usage and appraisal process.

Other suggestions were also provided by the experts, yet were disregarded due to several factors. One criticism was related to the similarity between specific and generic practices.

This can be justified by looking more intently into the model and understanding its components. The specific practices are oriented towards processes used on the project level while the generic practices (GP 2.1 and above) are focused on the standardisation and definition of the processes amongst all the projects that are functioning in the contracting company. As an example, achieving the specific goal related to training staff means that staff are receiving training in that particular project.

On the other hand, the same phrase being used in a generic practice implies that training is being provided to personnel working in all of the projects in a more institutionalised fashion. Therefore, having mutual wording between the specific practices and generic practices is effective in indicating if a practice is missing in a particular project or is it generally lacking from all the projects that are run by the same contracting company.

Another expert suggested starting from level 1 rather than level 0 to indicate the first capability level. Since this model is built on the basis of the CMMI model and refers to some parts of the CMMI model, it is more favourable to use the same terms that are mentioned in the CMMI to avoid any confusion in the model usage.

An expert also suggested adding an action plan to the appraisal cycle. The action plan preparation should be created by a responsible party that has authority within the organisation. Sufficient follow through of the action plan progress is necessary to see through the implementation of improvements to the process. Therefore the appraisal cycle of CMCMM should not include an action plan that needs to be generated internally from the organisation itself depending on the resources and dedication of the organisation for an improved change management process.

Some experts suggested that the model criteria should be customisable based on the organisational requirements and demands. The CMCMM utilises the same approach and was built on the basis of the CMMI which is used by more than five thousand organisations located in more than seventy countries.

Nonetheless, CMMI does not allow the customisation of the improvement criteria from one organisation to the other. As a result, consistency in the CMMI model is assured and the meaning behind each capability level achieved in different organisation remains comparable and represents the achievement of the same criteria. Additionally, taking into consideration that this criteria was built in conjunction with industry professionals working in range of contracting company sizes, experiences and specialisations, it can be deemed that this representative sample of the bigger population chose that the criteria is applicable to any contracting company in Kuwait. Therefore, it is not proper for this model to be broken down and customised as it will lose its value in establishing a proper change management process and will allow practices gaps.

8.3 PRACTICAL SETTING EVALUATION - CASE STUDIES

Following the domain experts review, the practical setting evaluation took place using the case study approach. The outcome of the practical setting evaluation should potentially contribute to improving the capability maturity model itself and the evaluation process (Salah *et al.*, 2014) and ensure that is empirically based (Wendler, 2012). The CMCMM model was used to deeply explore the ability of the three contracting organisations to conduct the change management practices that are necessary within each change management stage.

The data collected from the case studies was statistically analysed and was used to highlight the ability of CMCMM to capture the actual change management capability level in the organisation and its degree of practicality. If the feedback was proven positive, CMCMM would be ready for usage by contractors in Kuwait. Otherwise, amendments should be introduced to optimise the capability model for enhanced usage and practical. CMCMM's components and user guide would be refined if criticised for inappropriateness, vagueness or improper fitness for purpose by the construction industry professionals. Additionally and as a byproduct of this stage, the change management capabilities were explored for the three case studies and a deeper perspective was provided about the current situation of change management processes in Kuwait.

8.3.1 Conducting the Case Studies

The CMCMM appraisal process was used in the three case studies as shown in Figure 8-1. Nonetheless, few minor modifications were implemented in the appraisal cycle for the purpose of this research. Since the objective of the appraisal is to verify CMCMM, there was no use of forming an appraisal team as the researcher was the one conducting the appraisal process. The appraisal process first starts with the planning phase. To assure the practicality and the value added through applying CMCMM in a contracting organisation, three different contracting organisations in Kuwait were chosen and contacted for the case studies. The criteria of choosing these three specific organisations included the number of years the organisations have been established, project specialisation and the categorisation as per the Central Tenders Committee (CTC) of Kuwait.

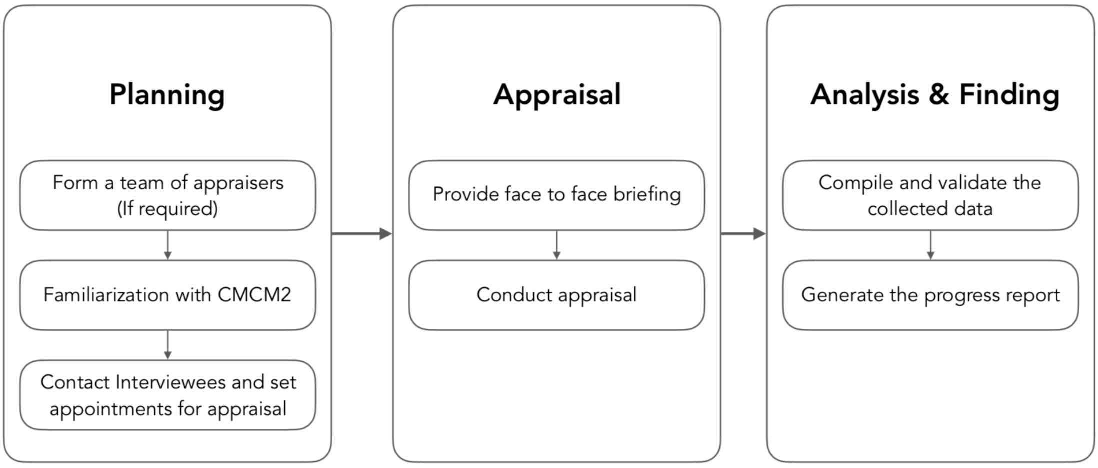

Figure 8-1 The CMCMM Appraisal Process

The organisations that were chosen are well-established, highly esteemed and known for their good reputation and high quality of work in Kuwait. These organisations have also been collectively involved in a diverse range of project types including residential, commercial, infrastructure, road, drainage, industrial and oil and gas construction projects. The case studies included contracting organisations that are classified as first, second and third category as per the CTC classification. The main purpose of this particular selection criterion is that by the end of conducting the three case studies, CMCMM's practicality and validity would be verified across contracting companies with different organisational size and capital. There was no need to have a fourth case study as data saturation was reached through ensuring that CMCMM works across three contracting companies that have diverse characteristics in addition to requesting the participants feedback on improving the model and the appraisal process. Additionally, contracting companies in category three and four are rather similar according to the Central Tenders Committee criteria when it comes to the company number of employees, capital and types of project they can tender for (CTC, 2016). Therefore, it was deemed by the researcher that conducting three case studies were sufficient to ensure the practicality and validity of the developed model.

The researcher arranged a meeting with the point of contact (either upper management or the owner) for each organisation for the preparation purposes of the appraisal process. The meeting aimed at providing information regarding the necessary appraisal duration, data collected and staff involvement in the case study interviews. The researcher pointed out that the staff involved should be well exposed to management processes of the organisation and would have an adequate experience years within the contracting organisation itself. The interviewees should also have a construction related educational background in order to contribute valid information to the research.

Both staff that are based in the construction site and the main office were involved in the process as this will provide a more complete picture of the change management capability level of the organisation. The researcher also provided an overview of the CMCMM user guide, appraisal checklist and appraisal report to the manager/owner to familiarise them with the research objective and contribution to the body of knowledge. Another critical aspect which researcher confirmed is that the interviews should be conducted as efficiently as possible in a way that does not jeopardise the interviewee's ability to conduct the tasks assigned to him/her. For this purpose the researcher suggested to conduct the interviews individually with each participant in his/her workplace whether that was the site office or the main office as a step to avoid disrupting any project activities. Individual interviews also contributes to avoiding any group influences when indicating the available and absent practices in the organisation.

Moreover, the researcher clearly mentioned that a questionnaire survey should be filled by the interviewee after the appraisal to gain a perspective towards the success, practicality and validity of the model. The questionnaire survey focused on the CMCMM criteria, improvement representation, appraisal cycle, user guide and the model's general practicality and validity. The questionnaire also features a comments section for any additional suggestions for improvement by the interviewees. The main purpose of using this questionnaire is to study the effectiveness of the model upgrades which were based on the comments/suggestions of the domain experts review (in the previous stage) and to highlight any other potential improvements. Most of the questions featured in this survey are similar to the ones handed previously to the domain experts to allow a valid comparison of the results and test the effectiveness of the model's refinements. The major difference between the two questionnaires is that the one used in the case studies features a section concerning the newly developed CMCMM user guide which was not previously reviewed by the domain experts. The questionnaire survey used in the case studies is shown in Appendix M.

The support of upper manager/owner of the organisations was secured and the contact information for the suitable professionals was provided. Nonetheless, this support was provided under the condition of complete anonymity when it comes to the organisation's identity in the research and only a limited access to documentation was granted.

The researcher then contacted the interviewees to set an appointment and conduct the appraisal. An overview of the appraisal process was provided over the phone and the permission of the manager/owner was to conduct this interview was confirmed. Furthermore, the researcher confirmed that the participants responses will be anonymous to ensure the validity of the responses and avoiding any inclinations to misrepresent the reality of the organisation. The formation of an appraisal team was deemed redundant in this situation as the appraisal was conducted for the purpose of this research thus was completed exclusively by the researcher.

After scheduling the appointments with the interviewees, the appraisal process should take place to establish which practices are conducted within the organisation. No tangible evidence was requested from the organisations for confidentiality purposes and general accessibility restrictions. Nonetheless, evidence could requested by the author to further investigate the presence or absence of a certain practice when different perspectives are provided. The researcher conducted these appraisals face to face in order to observe any comments or difficulties faced by the interviewee from the appraisal process. The researcher also kept in mind that the enhanced model and related tools should solve the issues that were previously pointed out by the expert domain evaluation. For instance, any confusion due to the model criteria or model improvement representation was noted for further possible refinement of the model and its components. In order to validate the ability of the appraisal checklist to capture the real change management capability, at least eight interviewees within the same organisation were requested to participate in the appraisal. The interviewees were finally requested to fill in the questionnaire survey regarding the validity of the model after being part of the appraisal process. The true degree of the model's practicality should be clarified at this stage as it is applied in a workplace setting and involves actual construction professionals working in contracting companies located in Kuwait.

8.3.2 Analysing of Results

The results of the appraisal are automatically previewed in the appraisal output report. The report will calculate the change management capability level, indicate which practices and goals were fulfilled and which were incomplete, calculate the completion percentage of the specific goals based on the weight of the completed specific practices and show an illustrative chart of the specific goals completion profile. Any additional comments and findings mentioned in the appraisal checklist will also be transferred to the appraisal report.

In case of inconsistent responses by different interviewees for a particular practice, an investigation will be initiated to discover the root cause of this dissimilarity and the extent of its connection to the model's practicality and fitness for purpose. The researcher contacted the participants and asked specific questions to ensure that a clearer picture is drawn. Since these case studies are conducted for research purposes rather than an actual and official capability appraisal, objective evidence will not be requested from the participants to abide by the organisational constraints when it comes to confidentiality and sharing information. Verbal confirmation is sufficient to determine if the contradicting opinions were caused by the vagueness or impracticality in any CMCMM component or if it is it sourced to a non-model related reason such an practices inconsistencies or participant's ignorance to some aspect of the used change management process.

After investigating the contracting responses and clarifying any ambiguities, the output report will be created and sent to the point of contact in the organisation's with recommendations on the improvement steps to be taken by the organisation. The report would be sent along with an appreciation letter to the organisation for its contribution to this research.

Additionally, the questionnaire results would also be quantitatively analysed in order to verify the degree of practicality and value added by the improved CMCMM model components, the user guide and the appraisal cycle. The data collected from this survey was quantitatively analysed to understand the extent of the potential value added by the model in the actual practical setting.

8.3.3 Case Study 1

The first case study featured Company A that was classified as a first category as per the Central Tenders Committee of Kuwait and is perceived as one of the top performing contracting companies in Kuwait. The company was established in 1962 in Kuwait with a total capital of USD 45,000 as a limited liability company. After being successful and gaining a good reputation in Kuwait the company became a publicly traded shareholding company with more than USD 50 million of capital. Revenues of Company A have exceeded USD 700 million in the recent years thus proving itself as one of the fierce competitors in the Kuwaiti construction industry. For the past years, Company A has exceeded expectations in terms of organisation growth and quality of project delivery. The company currently employs more than 10,000 employees working on its diverse projects. The company is involved a wide array of project types with both public and private clients. High profile clients in this company include the Kuwait Oil Company (KOC), Kuwait National Petroleum Company (KNPC), Ministry of Public Works, Ministry of Electricity and Water, Ministry of Defense, Public Authority for Housing Welfare, Ministry of Education and more. The company uses different types of contracts such as lump sum, remeasure and cost plus contracts.

The profile of the participants from Company A is shown in Table 8-4. The participants were all experienced in the construction industry and had a minimum experience of four years within the current company. The participants' current positions included both site based and office based professionals that may contribute highly to the output. Most of the participants received education to the bachelors level with only two having completed a masters degree. The education received by the participants is all relevant to the engineering domain.

Table 8-4 Profile of participants from Company A

No.	Current Position	Educational Background	Experience (Current Company)	Experience (Total)
1	Section Engineer	Bachelors Degree	9	10
2	Site Engineer	Bachelors Degree	5	6
3	Deputy Project Manager	Bachelors Degree	14	21
4	Project Manager	Bachelors Degree	19	28
5	Project Coordinator	Bachelors Degree	11	16
6	Logistics Manager	Bachelors Degree	17	31
7	Section Engineer	Masters Degree	7	12
8	Site Engineer	Bachelors Degree	4	4
9	Construction Manager	Masters Degree	15	26
10	Procurement Engineer	Bachelors Degree	6	13
11	Quantity Surveyor	Bachelors Degree	8	22
12	Site Engineer	Bachelors Degree	4	5

Through using the CMCMM appraisal tool, the participants were requested to indicate the availability of specific and generic practices within the contracting organisation. Table 8-5 shows the responses indicated by the participants. The checkmark indicates the practices that are used in the organisation while the blank cells indicate the missing practices. More details about the specific practices are featured in Appendix J.

Table 8-5 Responses in Case Study 1

Practice	Participant No.											
	1	2	3	4	5	6	7	8	9	10	11	12
SP1.1	√	√	√	√	√	√	√	√	√	√	√	√
SP1.2	√	√	√	√	√	√	√	√	√	√	√	√
SP1.3	√	√	√	√	√	√	√		√	√	√	√
SP1.4	√	√	√	√	√	√	√	√	√	√	√	√
SP1.5												
SP1.6												
SP2.1	√	√	√	√	√	√	√	√	√	√	√	√
SP2.2	√	√	√	√	√	√	√	√		√	√	√
SP2.3	√	√	√	√	√	√	√	√	√	√	√	√
SP2.4	√	√	√	√	√	√	√	√	√	√	√	√
SP2.5	√	√	√	√	√	√	√	√	√	√	√	√
SP3.1	√	√	√	√	√	√	√	√	√	√	√	√
SP3.2	√	√	√	√	√	√	√	√	√	√	√	√
SP3.3	√	√	√	√	√	√	√	√	√	√	√	√
SP3.4	√	√	√	√	√	√	√	√	√	√	√	√
SP3.5	√	√	√	√	√	√	√	√	√	√	√	√
SP3.6	√	√	√	√	√	√	√	√	√	√	√	√
SP4.1												
SP4.2												
SP4.3	√	√	√	√	√	√	√	√	√	√	√	√
SP5.1	√	√	√	√	√	√	√	√	√	√	√	√
SP5.2												
SP5.3												
SP6.1	√	√	√	√	√	√	√	√	√	√	√	√
SP6.2	√	√	√	√	√	√	√	√	√	√	√	√
SP6.3												
SP6.4	√	√	√	√	√	√	√	√	√	√	√	√
SP6.5	√	√	√	√	√	√	√	√	√	√	√	√
SP7.1	√	√	√	√	√	√	√	√	√	√	√	√
SP7.2												

Practice	Participant No.											
	1	2	3	4	5	6	7	8	9	10	11	12
SP7.3												
SP7.4												
SP8.1	√	√	√	√	√	√	√	√	√	√	√	√
SP8.2	√	√	√	√	√	√	√	√	√	√	√	√
SP8.3	√	√	√	√	√	√	√	√	√	√	√	√
SP9.1	√	√	√	√	√	√	√	√	√	√	√	√
SP9.2	√	√	√	√	√	√	√	√	√	√	√	√
SP9.3	√	√	√	√	√	√	√	√	√	√	√	√
SP9.4	√	√	√	√	√	√	√	√	√	√	√	√
SP9.5	√	√	√	√	√	√	√	√	√	√	√	√
SP10.1	√	√	√	√	√	√	√	√	√	√	√	√
SP10.2												
SP10.3												
SP10.4	√	√	√	√	√	√	√	√	√	√	√	√
SP11.1	√	√	√	√	√	√	√	√	√	√	√	√
SP11.2	√	√	√	√	√	√	√	√	√	√	√	√
SP11.3	√	√	√	√	√	√	√	√	√	√	√	√
SP12.1												
SP12.2												
SP12.3	√	√	√	√	√	√	√	√	√	√	√	√
SP12.4	√	√	√	√	√	√	√	√	√	√	√	√
SP12.5	√	√	√	√	√	√	√	√	√	√	√	√
GP 1.1												
GP2.1												
GP2.2												
GP2.3	√	√	√	√	√	√	√	√	√	√	√	√
GP2.4	√	√	√	√	√	√	√	√	√	√	√	√
GP2.5	√	√	√	√	√	√	√		√	√	√	√
GP2.6	√	√	√	√	√	√	√	√	√	√	√	√
GP2.7	√	√	√	√	√	√	√	√	√	√	√	√
GP2.8	√	√	√	√	√	√	√	√	√	√	√	√

Practice	Participant No.											
	1	2	3	4	5	6	7	8	9	10	11	12
GP2.9	√	√	√	√	√	√	√	√	√	√	√	√
GP2.10	√	√	√	√	√	√	√	√	√	√	√	√
GP3.1												
GP3.2												

It is required to confirm the validity of the information prior to filling the finalised appraisal checklist that will be used to generate the output report. Most of the responses indicated were perceived as valid based on the clear consistency except for three cases only which featured practices SP1.3, SP2.2 and GP2.5. These specific practices were shown in Table 8-5 to point out the need for further investigation of this contradiction's main cause.

The researcher took the liberty of contacting participants No.8 and No.9 regarding their responses as they were the only respondents to provide a response that can be perceived as an outlier. For participant No.8, SP1.3 and GP2.5 which both were related to training were marked as absent from the organisation to the contrary of the opinions of the remaining eleven professionals who are working within the same organisation. After investigation, participant No.8 indicated that no specific training for change management was delivered, yet a general project management fundamentals training was provided to staff. The researcher then asked a probing question to understand if change management was delivered within this training and the participant responded positively and confirmed that two sessions covered some aspects such as change control and configuration management. Apparently, there was a misconception by participant No.8 through assuming that these practices required a training course that exclusively focuses on change management without any other project management disciplines.

This information was confirmed with participants No.1 and No.2 who indicated that they confirmed the availability of change management training based on the same project management fundamentals course. As a result the researcher concluded that training was actually delivered in the organisation thus considered SP1.3 and GP2.5 as complete in the appraisal. There was no need to amend the phrasing of both practices as the abundant majority of the participants perceived them correctly and responded similarly with one exception being participant No.8.

Next, Participant No.9 was contacted regarding his response for SP2.2 which focused on circulating awareness emails. Since this practice in featured in CMCMM which focuses on change management, it is implicit that the emails should be focused on promoting the knowledge, competence and awareness of the project team regarding change management. Participant No.9 insisted that the response was correct as awareness emails were regularly sent but did not mention information about change management. Participant No.9 stated that the awareness emails are actually sent, yet do not mention change management or any part of its components in any capacity. The researcher accordingly contacted several participants to confirm the understanding of the practice SP2.2 and reevaluate its presence within the organisation.

As a conclusion the contacted participants expressed that awareness emails were truly not concerned with change management and rather focused on other topics such as safety matters, certification requirements or updates of rules and regulations rather than change management. Evidently, the researcher marked SP2.2 as missing in the finalised appraisal checklist to reflect the recent update to this matter. Finally, to avoid this misunderstanding, it was deemed necessary to rephrase this specific practice to "circulate awareness emails regarding change management" rather than the current practice "circulate awareness emails" in order to better reflect the intent of the specific practice itself.

After validating the collected information and filling the final appraisal checklist accordingly, the output report was generated as shown in Figure 8-2. The figure shows the concluded capability level, the progress in achieving the specific and generic goals progress and finally the specific goals progress profile.

Company A has achieved a capability level 0 when it comes to change management. The reason behind this classification is that there were specific practices missing thus eight specific goals were not completed. As a result, SG1 was incomplete as it depends exclusively on the achievement of all the specific practices. Since SG1 was missing and subsequently GG1 would be missing, a capability level of 1 was not obtainable within Company A.

Company A has successfully achieved SG3, SG8, SG9 and SG11. Only one practice was missing to complete SG2 which was SP2.2 that is concerned with the circulation of change management related awareness emails. SG6 was 90% completed and required the achievement of SP6.3 which is concerned with the usage of the earned value methods in evaluating project change. SG1, SG4, SG7, SG10 and SG12 were partially complete due to the absence of two or more specific practices in each of these goals. SG5 was specifically the least achieved goal with only 20% achievement indicated in this case study.

CMCM2 Report

Capability Level	0

		Progress
Specific Goals	SG1	72%
	SG2	82%
	SG3	100%
	SG4	33%
	SG5	20%
	SG6	90%
	SG7	66%
	SG8	100%
	SG9	100%
	SG10	49%
	SG11	100%
	SG12	51%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived

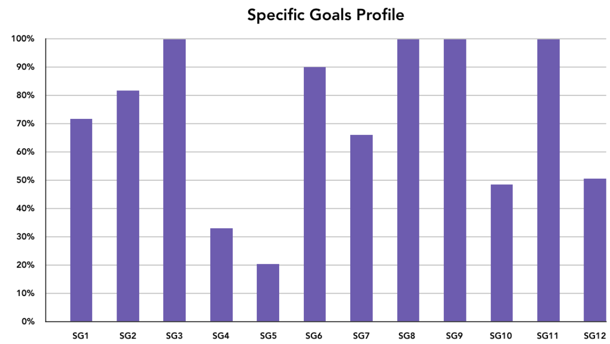

Figure 8-2 Case study 1 capability level, goals progress and specific goals profile

When observing the specific goals progress profile, it can be identified that there is no one specific change management stage that is conducted in a complete manner within Company A. The range of goal completion is relatively high when it comes to promoting a balanced change culture with a completion range starting between 72% and 82% for SG1 and SG2. The sufficiency of specific goals related to identifying change is clearly less with a completion percentage of only 20% and 33% for SG5 and SG4 respectively. Even though SG 3 was complete in change identification, it is necessary to take action to increase the completion percentage of the other specific goals that focus on change identification in the project. SG5 was focused on the identification of project changes through using value management, Building Information Modelling (BIM) and the usage of standard forms and documentation.

When looking at SP5.2 and SP10.3, it is clear that the organisation does not use BIM for identifying possible changes or implementing approved project changes. It is clear that SG5 is the weakest area that should be the starting point for improvement in Company A to enhance the change management capability of the organisation. SG4 on the other hand focused on the usage of change prediction tools, information database and root cause analysis in identifying change. The company clearly depends on other methods to identify change which is resembled by the completion of the other specific practices that are connected to change identification stage.

The first generic goal GG1 was automatically not achieved as it depends on the completion of GP1.1 that requires the completion of all the specific practices. A state that was not reflected in Company A. It is worth noting that eight out of ten generic practices that are required by GG2 was successfully completed. This implies that the organisation provides resources, assigns responsibilities, provide training, control outputs, objectively evaluate processes, monitor and controls processes, identify and involve the relevant stakeholders and reviews the status with higher management when it comes to the project change management capability throughout the company. The missing generic practices were planning for the process according to organisational standards and establishing an organisational policy regarding project change management. GG3 which requires the ability to conduct a defined process was not satisfied in Company A.

Clearly and since capability level 0 was achieved by Company A, a range of practices and tools are used to manage project change yet lacks the usage of the full range of specific practices to be declared as possessing a complete change management process (capability level 1). Company A should aim first at completing the array of practices required for a successful change management process. Next, Company A should be on standardising the change management process amongst all the projects and generate a tailoring guideline to fit the differing projects parameters and constraints.

8.3.4 Case Study 2

The second case study features Company B which is classified in the second category in the Central Tenders Committee of Kuwait. The company was established in 1996 as a limited liability company and has since held an excellent reputation in performance and professionalism in the local industry. The capital used in the incorporation was approximately USD 20,000. This capital has now has grown to USD 1.5 million with more than 1000 employees. Due to concerns of confidentiality, the researcher did not receive a confirmation on the exact revenue of Company B. Nonetheless, given the available public information, Company B may have an annual revenue of USD 5 million. Company B has recently acquired the ISO 9001 certification which proves the high ability of the organisation to properly conduct processes and optimise outcomes. Company B has successfully completed and is currently involved in a wide range of projects including residential, commercial, hotels, showrooms, clinics, educational institutions and also contributed to the construction of the iconic overhead water tanks as a subcontractor. The company is focused on adding value to their customers in each and every project it delivers with a corporate motto that endorses the premium quality and utmost reliability. The company uses different types of contracts depending on the project type and constraints including lump sum, re-measure and cost plus contracts.

The profile of the participants of Company B is shown in Table 8-6. All the participants in this case study has sufficient construction industry related experience. The minimum overall experience of these participants in the same company was 4 years. The minimum years of experience within the same company was perceived as sufficient to the researcher as the practitioner would have a high degree of familiarity with organisational processes. To enhance the validity of the data, both professionals working on site and in the office participated in the case study. This will in turn provide an “all around” perspective as to what constitutes the process of change management in Company B. The educational level of all the participants was a minimum of bachelors degree within the engineering domain. Nonetheless, one of the participants has achieved a higher degree of education through receiving a masters degree in construction management and structural design.

Through using the CMCMM appraisal tool, the participants were requested to indicate the presence of the specific and generic practices within the contracting organisation. Table 8-7 shows the responses indicated by where the checkmark indicates conducted practices and the blank cells indicates the ones missing from the organisation.

According to the CMCMM appraisal cycle, the data should be compiled and validated. Any inconsistencies should be further investigation for better understanding. After validating the responses, the finalised appraisal checklist can be filled to represent the actual state of the organisation. When compared to the first case study, the responses collected in this case study were relatively less consistent and coherent in demonstrating the conducted change management practices.

Table 8-6 Profile of participants from Company B

No.	Current Position	Educational Background	Experience (Current Company)	Experience (Total)
1	Projects Director	Bachelors Degree	19	32
2	Site Engineer	Bachelors Degree	4	6
3	Subcontracts Manager	Bachelors Degree	8	15
4	Planning Engineer	Masters Degree	6	6
5	Project Manager	Bachelors Degree	16	18
6	Project Manager	Bachelors Degree	14	36
7	Site Engineer	Bachelors Degree	5	7
8	Site Engineer	Bachelors Degree	4	5

Table 8-7 Responses in Case Study 2

Practice	Participant No.							
	1	2	3	4	5	6	7	8
SP1.1	√	√	√	√	√	√	√	√
SP1.2	√	√	√	√	√	√	√	√
SP1.3	√		√		√	√		
SP1.4	√		√	√	√	√	√	
SP1.5	√		√		√	√		
SP1.6								
SP2.1	√	√	√	√	√	√	√	√
SP2.2								
SP2.3	√	√	√	√	√	√	√	√
SP2.4	√	√	√	√	√	√	√	√
SP2.5	√	√	√	√	√	√	√	√
SP3.1	√	√	√	√	√	√	√	√
SP3.2	√	√	√	√	√	√	√	√
SP3.3	√	√	√	√	√	√	√	√
SP3.4	√	√	√	√	√	√	√	√

Practice	Participant No.							
	1	2	3	4	5	6	7	8
SP3.5	√	√	√	√	√	√	√	√
SP3.6	√	√	√	√	√	√	√	√
SP4.1								
SP4.2	√	√	√	√	√	√	√	√
SP4.3								
SP5.1								
SP5.2								
SP5.3	√	√	√	√	√	√	√	√
SP6.1	√		√	√	√	√	√	
SP6.2	√	√	√	√	√	√	√	√
SP6.3								
SP6.4								
SP6.5	√	√	√	√	√	√	√	√
SP7.1	√	√	√	√	√	√	√	√
SP7.2								
SP7.3								
SP7.4								
SP8.1	√	√	√	√	√	√	√	√
SP8.2	√	√	√	√	√	√	√	√
SP8.3	√	√	√	√	√	√	√	√
SP9.1	√	√	√	√	√	√	√	√
SP9.2	√	√	√	√	√	√	√	√
SP9.3	√	√	√	√	√	√	√	√
SP9.4	√	√	√	√	√	√	√	√
SP9.5								
SP10.1	√		√	√	√	√	√	
SP10.2								
SP10.3								
SP10.4	√	√	√	√	√	√	√	√
SP11.1	√	√	√	√	√	√	√	√
SP11.2	√	√	√	√	√	√	√	√

Practice	Participant No.							
	1	2	3	4	5	6	7	8
SP11.3	√	√	√	√	√	√	√	√
SP12.1	√	√	√	√	√	√	√	√
SP12.2								
SP12.3	√	√	√	√	√	√	√	√
SP12.4	√		√	√	√	√	√	
SP12.5	√	√	√	√	√	√	√	√
GP 1.1								
GP2.1					√			
GP2.2	√	√	√	√	√	√	√	√
GP2.3	√	√	√	√	√	√	√	√
GP2.4	√	√	√	√	√	√	√	√
GP2.5	√		√		√	√		
GP2.6	√	√	√	√	√	√	√	√
GP2.7	√	√	√	√	√	√	√	√
GP2.8	√	√	√	√	√	√	√	√
GP2.9	√	√	√	√	√	√	√	√
GP2.10	√	√	√	√	√	√	√	√
GP3.1								
GP3.2								

As a result of the inconsistencies, eight cases of conflicting opinions were investigated in Company B through contacting several participants and making judgements accordingly.

First, participants No.2 and No.8 indicated that SP1.4, SP6.1, SP10.1 and SP12.4 were not used in Company B to the contrary of the indications of the remaining participants. All of these specific practices were focused on the usage of change logs in several change management stages. The researcher first contacted participants No.1 and No.3 to confirm the availability of the change logs.

It was then revealed that the change logs are actually used throughout the change management process yet is not necessarily shared with all the project team for confidentiality purposes. Participant No.4 (planning engineer) confirmed that change logs are not shared with site engineers where they are only required to provide updates about the change status with either the project manager, the assistant project manager or the subcontract manager being in charge of updating and maintaining the change log accordingly. The same information was confirmed by participant No. 5 (project manager). Since participants No.2 and No.8 had the same position which is “site engineer”, the change logs were not previously shared with them and therefore indicated that these logs did not exist. As a result, no knowledge was gained from these change logs by both these participants and SP1.4 was considered incomplete as it depends on promoting a balanced change culture through enabling the team members to learn about possible project changes from previous project change logs. SP6.1, SP10.1 and SP12.4 were considered as complete as the change log was actually used by decision makers to evaluate and implement changes in addition to continuously being maintained and updated till the end of the project as confirmed by participant No.6.

Participants also provided inconsistent responses in regards to SP1.5 that focuses on checking the change readiness of the project team. Participants No. 2, 4, 7 and 8 indicated that there was no official audit for change preparedness while the other participants indicated that there actually was such an audit. Participant No.1 justified this through stating that similar to the ISO auditing, it is not necessary to test each and every team member for change preparedness as only a sample would suffice. Participant No. 3 agreed through confirming that he was part of the “project management processes” audit which focused on the ability to conduct different processes including the practices required to manager change. Participant No. 3 mentioned that standard documentation related to change management was created and used in Company B for the sole purpose of managing change consistently. Based on this information, SP1.5 was marked as complete in the finalised checklist.

Only participant No. 5 indicated that GP2.1 which is concerned with availability of an organisational policy regarding change management to the opposite of the remaining participants. This participant was also contacted to justify his opinion and confirmed that the an organisational policy was referring to using the PMBOK practices as a general guideline in managing the project activities. Participant No. 5 indicated that implicitly, some portions of the change management process is actually mentioned in the PMBOK. That would be in addition to organisation’s policy to adopt the ISO standard which also touches to a certain degree managing change to the process outputs. As a result, it was indicated that an organisational policy is actually set for change management and that GP2.1 was accomplished in Company B.

The last two cases of contradicting opinions were SP1.3 and GP2.5 which are both connected to providing change management training for staff either independently or as part of a bigger project management training course. Most of the participants indicated the absence of this practice in Company B. Interestingly, participants that are in a managerial position indicated the opposite as they confirmed that they received training in the appraisal process. After contacting several participants, it was confirmed that project management related training (including change management) is delivered exclusively to staff with managerial positions only. On this basis SP1.3 and GP2.5 were perceived as missing in the finalised appraisal form since not all the relevant team members were properly trained and prepared for a project change event. For instance, it is essential to provide change management related training to participants No. 2, 7 and 8 who are site engineers and could be directly exposed to site related changes. Therefore, since such key personnel were not trained, it is not appropriate to consider both these practices as adequate.

Evidently, the contradicting responses in case study 2 was not connected to the CMCMM model thus no modification was seen as a necessity to any model component. It is rather organisational reasons such as gaps and inconsistencies in practices. Another reason was due to a lack of common understanding when it came to the coverage of the organisational policy.

After validating the collected responses, the final appraisal checklist was completed accordingly. The automated report showed the corresponding change management capability level, the progress in achieving the specific and generic goals progress and finally the specific goals progress profile for Company B as illustrated in Figure 8-3.

Company B has achieved a capability level 0 in change management according to the CMCMM criteria and improvement representation. This level was achieved since not all the specific practices were achieved in the organisation as shown by the appraisal results. The first generic practice GP1.1 is then automatically not achieved and capability level 1 would was not reached by Company B.

CMCM2 Report

Capability Level	0

		Progress
Specific Goals	SG1	55%
	SG2	82%
	SG3	100%
	SG4	56%
	SG5	59%
	SG6	67%
	SG7	66%
	SG8	100%
	SG9	92%
	SG10	49%
	SG11	100%
	SG12	71%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived

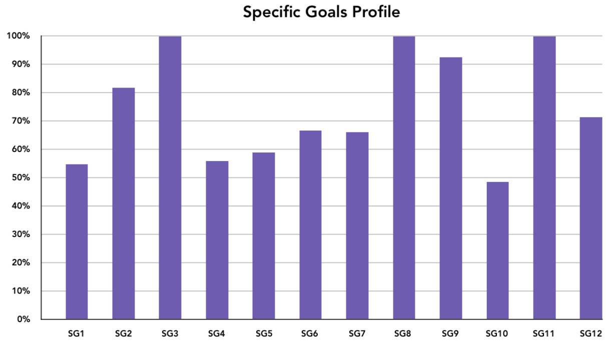

Figure 8-3 Case study 2 capability level, goals progress and specific goals profile

Company B has successfully completed specific goals SG3, SG8, SG11. SG9 was 92% complete and was only missing one practice which is SP9.5 that focuses on the implementation of minor changes that would not influence the project parameters or requirements without the client 's written approval. Participant No.1 commented on the absence of this particular practice through stating that it is absolutely non negotiable that as a contracting company needs to follow the contracts and specifications in the closest way possible and avoid deviation even if minor without the officially written consent from the client. SG2 was 82% complete and was also missing only specific practice that requires the circulation of awareness emails that increase the knowledge and competence of the team in managing project change. SG12 was only 71% complete due to missing a rather important practice with relatively high weight which is SP12.2 that requires the usage of a content management system in order to learn from the previously stored information related to the encountered project changes. Other specific goals were not achieved due to missing two or more specific practices in the organisation.

The least goal achieved was SG10 which was only 49% complete according to the appraisal report. This particular goal was not completely achieved since the usage of content management system and BIM was not used in implementing and monitoring change. These two practices accounted for 51% of the total weight of SG10 which indicates their high significance in the implementation and monitoring stage of managing project changes.

None of the generic goals were achieved by Company B. GG2 was missing only practice which was training personnel to be ready to manage change. A practice that was established to be missing for key team members such as site engineers who are one of the main stakeholders and should be at least capable of identifying site related changes as it occurs.

The specific goals profile of company did not provide any indication or any pattern within a particular change management stage. All of the goals that are grouped within each change management stage were either fully or partly addressed within the second case study. Therefore, the profile reveals that some practices are conducted within each change management stage yet are deemed to be incomplete in the perspective of the CMCMM criteria.

To achieve improvement within the change management capability and attain a capability level 1, Company B should target the realisation of all the required practices for a prosperous process. It is worth noting that Company B does use a range of standard forms and documentarians in all the change management stages except promoting a balanced change culture according to the received responses. An expected outcome as this organisation is ISO certified and would typically follows a rather systematic documentation protocol. Nonetheless, the documentation missed out on promoting a balanced change culture and this should be a point of focus within the organisation. Company B should subsequently shift its focus on achieving standardisation in the change management process followed by creating a capacity for tailoring this process to fit the different requirements for its project.

8.3.5 Case Study 3

The third case study features Company C which is a relatively small contracting company and is classified as a third category as per the Central Tenders Committee in Kuwait. Company C has been established for approximately fifteen years yet has gained a good momentum through being one of the most compelling contracting companies that are specialised in finishing design and execution related projects. The capital used for incorporation was approximately USD 15,000. This capital has recently grown to approximately USD 600,000. The number of employees in Company C is in the range of 100 employees thus is considered a rather small sized contracting company. The approximate annual profit of Company C is USD 200,000. The company has completed a huge number of "short-period" projects which lasts for less than a month and served highly esteemed international franchises such as Starbucks, Pinkberry, Dominos Pizza and other local franchises as well. Additionally, Company C is majorly involved in design and build projects for residential villas in Kuwait. They would be the only point of contact with the client and would be in charge of the comprehensive design process and construction works for remarkable housing. Company C is well known for its resilience and ability to adapt to changing client requirements and places customer satisfaction as the top priority in the organisation. The company deals primarily with lump sum contracts with the exceptional usage of remeasure contracts.

The demographics of the professionals participating in the third case study are shown in Table 8-8. These professionals were either based on site or in the main office with a minimum experience of three years and a maximum experience of 12 years in Company C itself. The educational background for most of the participants was relevant to engineering as they all achieved a bachelors of science or technology in civil engineering. The contract administrator originally received an education related to human resources yet has been extensively involved in the construction industry on a full time basis for the past seventeen years and specifically in Company C for the past 10 years in this same position. Therefore, it was recognised that the input of this participant would be valuable to the research outcome regardless of the education background in this case as an exception to candidate selection criteria of the case study.

Table 8-8 Profile of participants from Company C

No.	Current Position	Educational Background	Experience (Current Company)	Experience (Total)
1	Senior Site Engineer	Bachelors Degree	6	7
2	Project Manager	Bachelors Degree	12	19
3	Site Engineer	Bachelors Degree	4	5
4	Site Engineer	Bachelors Degree	3	3
5	Site Engineer	Bachelors Degree	5	5
6	Site Engineer	Bachelors Degree	3	4

No.	Current Position	Educational Background	Experience (Current Company)	Experience (Total)
7	Site Engineer	Bachelors Degree	4	4
8	Contract Administrator	Bachelors Degree	10	17
9	Senior Site Engineer	Bachelors Degree	7	9
10	Assistant Project Manager	Bachelors Degree	8	15
11	Project Manager	Bachelors Degree	11	24

These participants were interviewed for the appraisal in a face to face manner and the data was collected in independent appraisal checklists. After collecting the data, the responses were compiled to verify its consistency as shown in table 8-9. The consistency of responses was rather high in this case study when compared with the previous case studies. A reason could be that the company is smaller than the previous one and a shared perspective is more attainable. Another reason maybe that the majority of the change management practices were missing from Company C thus decreasing the capacity of inconsistent responses as most of the responses will indicate the major absence of these change management related practices. As a result, only one case of inconsistency was recognised after compiling all the responses as indicated in Table 8-9. The case required an additional investigation through contacting some participants for further clarification and elaboration.

Table 8-9 Responses in Case Study 3

Practice	Participant No.										
	1	2	3	4	5	6	7	8	9	10	11
SP1.1											
SP1.2											
SP1.3											
SP1.4											
SP1.5											
SP1.6											
SP2.1	√	√	√	√	√	√	√	√	√	√	√
SP2.2											
SP2.3	√	√	√	√	√	√	√	√	√	√	√
SP2.4	√	√	√	√	√	√	√	√	√	√	√
SP2.5	√	√	√	√	√	√	√	√	√	√	√
SP3.1	√	√	√	√	√	√	√	√	√	√	√
SP3.2	√	√	√	√	√	√	√	√	√	√	√
SP3.3	√	√	√	√	√	√	√	√	√	√	√
SP3.4											
SP3.5	√	√	√	√	√	√	√	√	√	√	√
SP3.6	√	√	√	√	√	√	√	√	√	√	√
SP4.1											
SP4.2											
SP4.3											
SP5.1											
SP5.2											
SP5.3											
SP6.1											
SP6.2	√	√	√	√		√		√	√	√	√
SP6.3											
SP6.4											
SP6.5											
SP7.1											
SP7.2											

Practice	Participant No.										
	1	2	3	4	5	6	7	8	9	10	11
SP7.3											
SP7.4											
SP8.1	√	√	√	√	√	√	√	√	√	√	√
SP8.2											
SP8.3	√	√	√	√	√	√	√	√	√	√	√
SP9.1	√	√	√	√	√	√	√	√	√	√	√
SP9.2	√	√	√	√	√	√	√	√	√	√	√
SP9.3											
SP9.4	√	√	√	√	√	√	√	√	√	√	√
SP9.5											
SP10.1											
SP10.2											
SP10.3											
SP10.4											
SP11.1	√	√	√	√	√	√	√	√	√	√	√
SP11.2											
SP11.3	√	√	√	√	√	√	√	√	√	√	√
SP12.1											
SP12.2											
SP12.3											
SP12.4											
SP12.5											
GP 1.1											
GP2.1											
GP2.2											
GP2.3											
GP2.4											
GP2.5											
GP2.6											
GP2.7	√	√	√	√	√	√	√	√	√	√	√
GP2.8	√	√	√	√	√	√	√	√	√	√	√

Practice	Participant No.										
	1	2	3	4	5	6	7	8	9	10	11
GP2.9	√	√	√	√	√	√	√	√	√	√	√
GP2.10	√	√	√	√	√	√	√	√	√	√	√
GP3.1											
GP3.2											

The respondents provided inconsistent responses in regards to SP6.2 that emphasises the usage of records management in the change evaluation stage. Only two respondents indicated that records management was not used in the organisation. After contacting both these participants and ensuring that they understand the meaning of the practice, it was concluded that did originally comprehend the meaning yet were not aware of the presence of such a practice in Company C. Therefore it was necessary to contact a few more participants who clearly indicated that records management is used in the company to further understand the situation. After contacting participant No. 2 and No.8, it was concluded that site engineers are not necessarily aware of the usage of records management as it is more inclined towards being an administrative and managerial type of practice. Thus it was confirmed by these participants that this practice is actually conducted in the organisation and should be accounted for as complete in the finalised appraisal checklist.

After solving the inconsistency dilemma, the final appraisal checklist was filled and the appraisal report was produced consequently. The report illustrated how Company C performed when it comes to the change management capability level, the progress in achieving the specific and generic goals progress and finally the specific goals progress profile for Company B as illustrated in Figure 8-4.

The report indicated that Company C's change management capability was at level zero based on the finalised appraisal results. Capability level 0 was attained since it was indicated that a big majority of the practices required by the CMCMM criteria was missing from the organisation. And since GP1.1 was not satisfied, the capability level 1 was not recognised by company C.

CMCM2 Report

Capability Level	0

		Progress
Specific Goals	SG1	0%
	SG2	82%
	SG3	90%
	SG4	0%
	SG5	0%
	SG6	22%
	SG7	0%
	SG8	47%
	SG9	73%
	SG10	0%
	SG11	9%
	SG12	0%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived

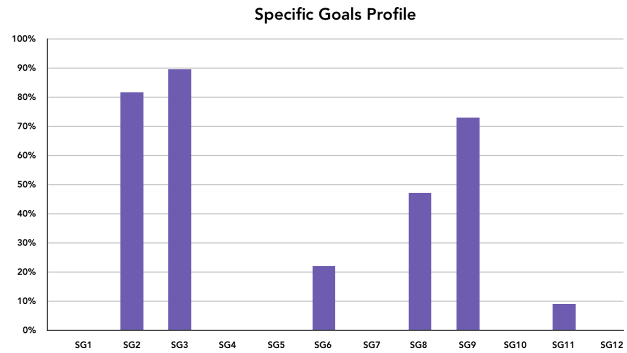

Figure 8-4 Case study 3 capability level, goals progress and specific goals profile

When observing the report output and particularly the specific goals profile, it can be realised that there exists major gaps in the change management process conducting in the organisation. Obviously, a zero completion in a specific goal was unprecedented prior to this case study as the previous cases did score low in some specific goals yet received a minimum score of 20% or 49% as shown in case study 1 and case study 2 respectively. This is an indication that project change is abundantly managed on an Ad-Hoc basis as huge chunks of several change management stages are not used in company C.

The practices required to satisfy six specific goals were completely nonexistent in Company C. The specific goals SG1, SG4, SG5, SG7, SG10 and SG12 scored 0% when calculating the amount of completeness. Other goals were closer to completion such as SG2, SG3 which were missing only one specific practice per goal to be completed. SG2 was only missing the practice of circulating awareness emails to the team members to increase their readiness for project changes and the way to deal with them properly.

SG3 was incomplete since the respondents indicated that the organisation does not utilise Microsoft Word and/or Microsoft Excel to describe the change cause(s). Participant No.1 was contacted and commented on the absence of this practice through stating that it is enough to describe the change cause over the phone or email when needed. This perspective was supported by the consensus on the availability of practice SP3.5 in the organisation which entails that verbal or written communication is used in the project change identification stage. SG6 was also one practice short to be complete yet this practice accounted for 78% of the total weight for that specific goal.

The specific practice SP8.2 was also related to using Microsoft Excel to evaluate the quantity and cost of project changes. When contacted, participant No.1 pointed out that most of the project changes faced are rather simple and straight forward when it comes to calculating their cost or quantity. Such calculations do not require the usage of any software as indicated by the participant due to the simplistic nature of most of the projects undertaken by Company C. On the other hand SG6, SG9, SG11 were lacking two or more specific practices in order to be complete. None of the generic goals were close to achievement by Company C.

To achieve a huge enhancement in the adequacy of the change management process within the company, a serious and systematic effort should be invested in conducting all the missing practices shown in the appraisal report. There is clearly a long way to go in order to gain the next level of capability according to the CMCMM requirements in the case of Company C, yet this effort will be a great asset to the organisation's resilience and ability to manage project change at an acceptable level rather than managing it on a random and non-systematic basis.

8.3.6 Discussion on the Three Case Studies

In the previous case studies, the researcher has conducted an appraisal to evaluate the change management capability of three different contracting companies that are operating in Kuwait. The change management capability levels were calculated for the three companies in addition to highlighting their areas of strengths and weaknesses in accordance with the research objective. This section focuses on comparing and discussing the results of the three case studies in order to recognise any trends in the change management implementation amongst the three cases.

First, the capability levels achieved in the three case studies should be compared. Figure 8-5 shows that the three case studies achieved a CL0 based on the CMCMM improvement criteria and improvement representation requirements.

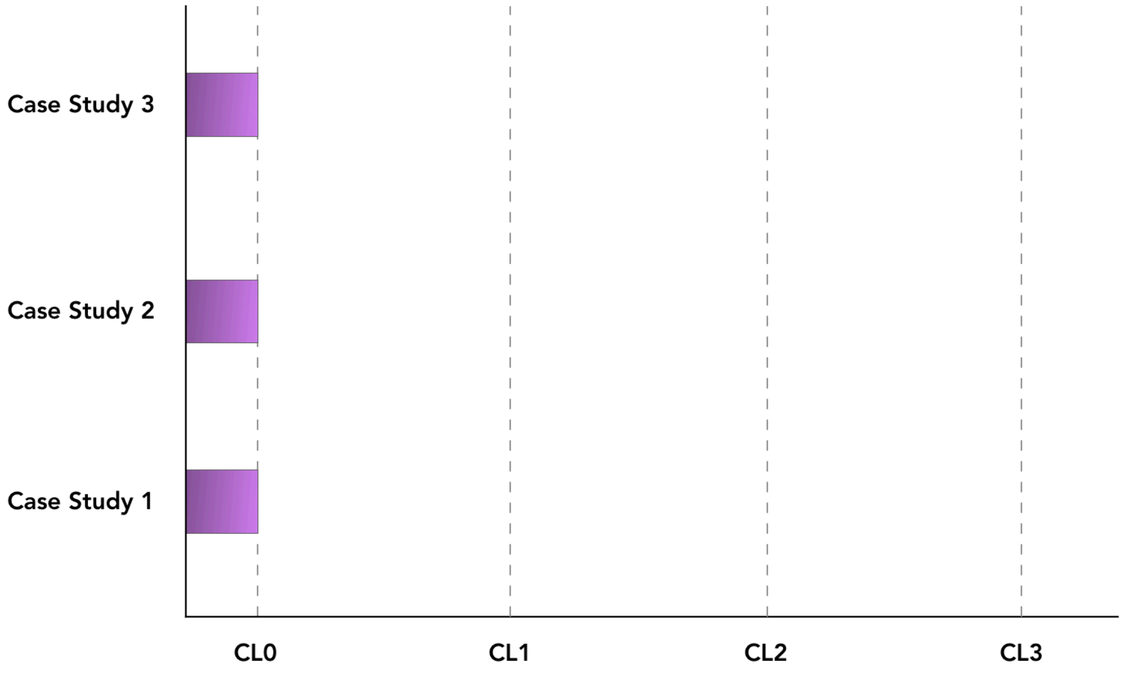

Figure 8-5 Capability levels achieved in the case studies

The three case studies achieved a capability level 0 according to the appraisal output. This level indicates that the companies either do not apply or apply partially the specific practices necessary for a successful change management process. Nonetheless, it is imprecise to imply that the same range of practices are used by the three organisations featured in the case studies. It is rather important to observe and compare the amount of progress towards achieving capability level 1 in the three cases. The importance of CL1 is that this level indicates that the organisation uses the full range of tools and practices to enhance its capability to manage the encountered change to an adequate level. To achieve CL1, all the specific practices featured in the CMCMM criteria must be conducted in the organisation to achieve all the specific goals. The weights of these practices contribute to calculating the progress of achieving each specific goal.

It is important to acknowledge the fact that choosing these three organisations would influence the concluded capability levels as different specific and generic practices would differ between different organisations. Nonetheless, it can be inferred from the three case studies that most contracting companies in Kuwait would have a gap in their change management processes when appraised. Otherwise, a higher capability level would be successfully indicated through the model.

Figure 8-6 illustrates a comparison between the specific goals achievement progress of the case studies through compiling the specific goals profile of the case studies. This figure provides an overview of the change management practices and tools sufficiency to achieve the twelve specific goals in the case studies.

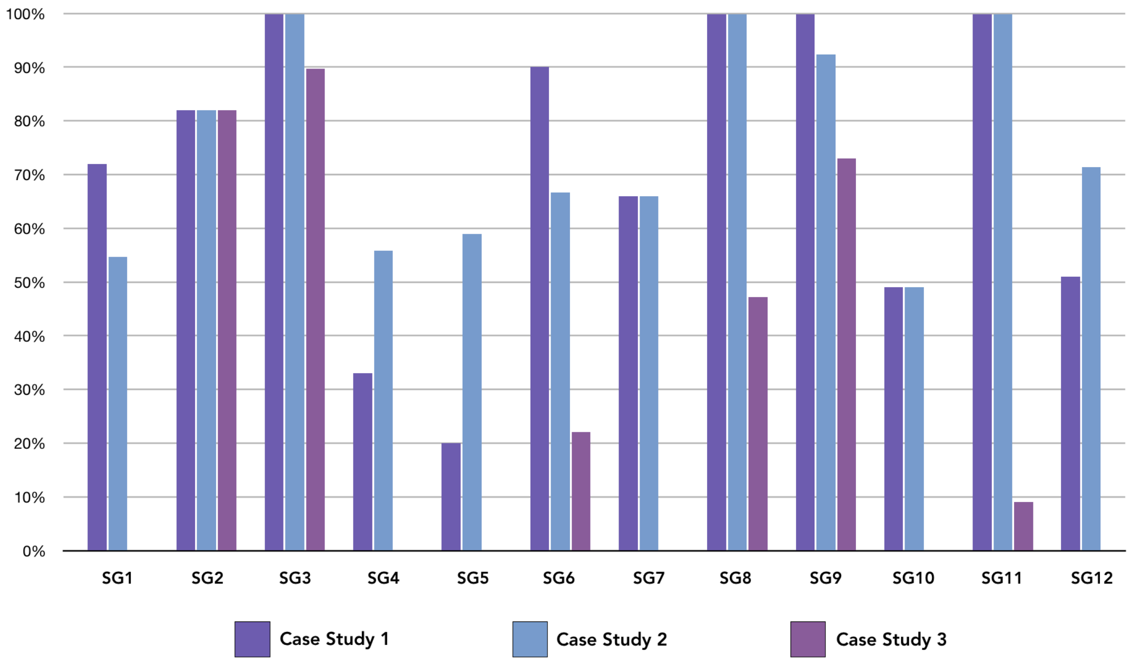

Figure 8-6 Specific goals profiles in the case studies

Clearly there seems to be some common grounds between the three cases when it comes to some specific goals achievements while the progress of achieving other specific goals varies widely. To investigate the presence of any patterns, Table 8-10 previews the achievement percentage of each goal as indicated in the previously generated appraisal reports of each case study. To allow statistical insight, the mean, standard deviation, minimum value, maximum value was calculated for the goals achievements across the case studies.

The highest mean across the specific goals was SG3 with a percentage of 97% amongst the cases. The scores of SG3 ranged from 90% as a minimum in case study 3 up to 100% that was fulfilled in the first and second case studies in addition to a 6% standard deviation thus indicating a rather proximate responses provided by respondents participating in the case studies. This goal is concerned with identifying project changes through comparing actual cost and quantities with approved BOQ, comparing actual quality with the contract requirements and specifications, comparing actual project progress with the project schedule, using Microsoft Word and/or Microsoft Excel for describing the change cause(s), communicating when a change occurs (verbally and/or writing) and finally using photos and/or videos for reporting the worksite related changes. It is rather safe to conclude that this goal was the most frequently fulfilled in these case studies.

Table 8-10 Specific goals progress in the case studies

	Specific Goals Progress						
	Case Study 1	Case Study 2	Case Study 3	Mean	St Dev.	Min.	Max.
SG1	72.00%	54.70%	0.00%	42.23%	37.58%	0.00%	72.00%
SG2	82.00%	82.00%	82.00%	82.00%	0.00%	82.00%	82.00%
SG3	100.00%	100.00%	89.70%	96.57%	5.95%	89.70%	100.00%
SG4	33.00%	55.80%	0.00%	29.60%	28.05%	0.00%	55.80%
SG5	20.00%	58.90%	0.00%	26.30%	29.95%	0.00%	58.90%
SG6	90.00%	66.60%	22.10%	59.57%	34.49%	22.10%	90.00%
SG7	66.00%	66.00%	0.00%	44.00%	38.11%	0.00%	66.00%
SG8	100.00%	100.00%	47.20%	82.40%	30.48%	47.20%	100.00%
SG9	100.00%	92.40%	73.00%	88.47%	13.92%	73.00%	100.00%
SG10	49.00%	49.00%	0.00%	32.67%	28.29%	0.00%	49.00%
SG11	100.00%	100.00%	9.00%	69.67%	52.54%	9.00%	100.00%
SG12	51.00%	71.40%	0.00%	40.80%	36.78%	0.00%	71.40%

To the contrary, the lowest mean of progress achieved for a specific goal was SG5 with the mean score of 26%. The minimum value for this goal was 0% as shown in case study 3 and the maximum value of 59% in case study 2. The standard deviation of 30% indicates that the three case studies do not have the same practices and tools application required to achieve SG5. For instance, case study 1 only uses value management while case study 2 uses both value management and standard forms and documentation in identifying change. Both case studies do not indicated the usage of BIM thus resulting in big reduction of the achievement progress of SG5. Case study 3 clearly does not use any of the practices required to achieve SG5.

When observing the amount of harmony in satisfying the specific goals, it can be recognised that SG11 was the most contradictory goal. The range of scores started from 9% all the way to 100% with a standard deviation of 53%. An indication of non coherence between the case studies when applying the practices required to achieve SG11. Nonetheless, it is worth highlighting that case study 1 and case study 2 indicated the full achievement of SG11 thus this standard deviation was exclusively rooted to the third case study. In the third case study, the company did not use two essential practices required for SG11 which were related to encouraging professional development related to change management and self-driven knowledge and skills enhancement. These two practices accounted for 91% of the total progress towards satisfying SG11.

On the other end of the spectrum, SG2 apparently has the highest degree of alignment among the three case studies. SG2 was 82% complete in the three case studies thus resulted in a standard deviation of 0%. This was the only standard deviation that was equal to zero when comparing between the case studies. Therefore, all companies featured in the case studies partially apply the same aspects of SG2 and do not apply the others. The only practice missing from this specific goal in all the case studies is related to circulating awareness emails regarding change management in order to improve the change readiness of the team and increase their skills and knowledge to deal with the situation. In the first case study, it was clarified that awareness emails were regularly sent yet not concerning change management.

Consequently, it is also helpful to conduct an investigation about the achievement of these specific goals that are connected to each change management stage was calculated as shown in Table 8-11. The achievement of specific goals related to promoting a balanced change culture (PCC), identifying change (IC), evaluating change (EC), implementing and monitoring change (IMC) and continuous improvement (CNT) was calculated for each case study. The mean of these goal achievements per stage was calculated to understand the overall situation of conducting change management in these cases studies.

When observing the results, the range of the mean goal completion per change management stage is fairly close throughout the five stages. The goals connected to promoting a balanced change culture and evaluating project change were the most accomplished as an mean with a 62% completion rate. The minimum goals achievement per stage was related to identifying change which achieved a mean value of 51%. Intermediate scores were achieved by the other change management stages with change implementation and monitoring achieving 61% and continuous improvement achieving 55% goals completion. Therefore, there seems to a relatively uniform distribution of goals accomplishment across all the change management stages. In other words, the practicers conducted in the three case studies caused the fulfilment of specific goals that are distributed in fairly even manner over the five change management stages with a range of 11% only when averaging the three case studies.

Table 8-11 Specific goals progress in each change management stages

	Specific Goals Progress			Case Study 1					Case Study 2					Case Study 3					Case Studies (Mean)				
	Case Study 1	Case Study 2	Case Study 3	PCC	IC	EC	IMC	CNT	PCC	IC	EC	IMC	CNT	PCC	IC	EC	IMC	CNT	PCC	IC	EC	IMC	CNT
SG1	72%	55%	0%	77%					68%					41%					62%				
SG2	82%	82%	82%																				
SG3	100%	100%	90%		51%					72%					30%					51%			
SG4	33%	56%	0%																				
SG5	20%	59%	0%																				
SG6	90%	67%	22%			85%					78%					23%					62%		
SG7	66%	66%	0%																				
SG8	100%	100%	47%																				
SG9	100%	92%	73%				75%					71%					37%					61%	
SG10	49%	49%	0%																				
SG11	100%	100%	9%					76%					86%					5%					55%
SG12	51%	71%	0%																				

To further understand the commonalities and differences between the cases on the practices level, Table 8-12 was complied to show the accumulated list of specific practices that were either indicated as applied or not in the case studies. The dichotomous values that represent either the presence of the specific practice (true) or the absence of this practice in each case study.

Evidently, there seems to be 16 specific practices that are applied in all the case studies. These practices tend to to be inclined towards the simple and basic means of communication and management processes in addition to the usage of readily available tools such as the Microsoft tools and scheduling related softwares. This may potentially be the main cause of having this mutual practices applied in the three cases as they seem to be cost effective and conveniently available in a typical contracting organisation.

Table 8-12 Specific practices progress in the case studies

Specific Practice	Case Study 1	Case Study 2	Case Study 3
SP1.1	FALSE	TRUE	FALSE
SP1.2	TRUE	TRUE	FALSE
SP1.3	TRUE	FALSE	FALSE
SP1.4	TRUE	FALSE	FALSE
SP1.5	FALSE	TRUE	FALSE
SP1.6	FALSE	FALSE	FALSE
SP2.1	TRUE	TRUE	TRUE
SP2.2	FALSE	FALSE	FALSE
SP2.3	TRUE	TRUE	TRUE
SP2.4	TRUE	TRUE	TRUE
SP2.5	TRUE	TRUE	TRUE
SP3.1	TRUE	TRUE	TRUE
SP3.2	TRUE	TRUE	TRUE
SP3.3	TRUE	TRUE	TRUE
SP3.4	TRUE	TRUE	FALSE
SP3.5	TRUE	TRUE	TRUE
SP3.6	TRUE	TRUE	TRUE
SP4.1	FALSE	FALSE	FALSE
SP4.2	FALSE	TRUE	FALSE
SP4.3	TRUE	FALSE	FALSE
SP5.1	TRUE	FALSE	FALSE
SP5.2	FALSE	FALSE	FALSE
SP5.3	FALSE	TRUE	FALSE
SP6.1	TRUE	TRUE	FALSE
SP6.2	TRUE	TRUE	TRUE
SP6.3	FALSE	FALSE	FALSE
SP6.4	TRUE	FALSE	FALSE
SP6.5	TRUE	TRUE	FALSE
SP7.1	TRUE	TRUE	FALSE
SP7.2	FALSE	FALSE	FALSE
SP7.3	FALSE	FALSE	FALSE
SP7.4	FALSE	FALSE	FALSE
SP8.1	TRUE	TRUE	TRUE
SP8.2	TRUE	TRUE	FALSE

Specific Practice	Case Study 1	Case Study 2	Case Study 3
SP8.3	TRUE	TRUE	TRUE
SP9.1	TRUE	TRUE	TRUE
SP9.2	TRUE	TRUE	TRUE
SP9.3	TRUE	TRUE	FALSE
SP9.4	TRUE	TRUE	TRUE
SP9.5	TRUE	FALSE	FALSE
SP10.1	TRUE	TRUE	FALSE
SP10.2	FALSE	FALSE	FALSE
SP10.3	FALSE	FALSE	FALSE
SP10.4	TRUE	TRUE	FALSE
SP11.1	TRUE	TRUE	TRUE
SP11.2	TRUE	TRUE	FALSE
SP11.3	TRUE	TRUE	FALSE
SP12.1	FALSE	TRUE	FALSE
SP12.2	FALSE	FALSE	FALSE
SP12.3	TRUE	TRUE	FALSE
SP12.4	TRUE	TRUE	FALSE
SP12.5	TRUE	TRUE	FALSE

For instance, SP2.1 depends on reviewing the feasibility of the contract requirements and the variation order clause. A practice that is considered as common as potentially possible for any respectable and experienced organisation. Another example is SP2.3 and SP2.4 where information is shared through either informal discussions or formal meetings. A method that is not resources consuming in any capacity thus represents a good opportunity to disseminate information related to change management across the entire project team. Practices such SP8.3 conveniently uses scheduling software that is regularly available within the typical contracting company with the most minimal resources.

The table also highlights 12 specific practices mentioned in the CMCMM criteria which are completely absent from the case studies. SP4.2 requires dedicated resources that may either be not available in these organisations or dedicated for other purposes other than change management. Some specific practices that were not used also requires a high dedication of resources and proper training to be properly conducted within the organisation. For instance, SP10.3 requires the usage of BIM in implementing and monitoring changes. This is a process that would be very demanding for a contracting company that does not originally use BIM and requires an adequate investment in both resources and training.

This is the same case as SP10.2 which requires an extensive effort to create the content management system (CMS) itself for the entire organisation and training the relevant stakeholders on using this practice. Nonetheless, it should be noted that the effort of implementing these specific practices will be rewarded through obtaining an enhanced outcome from managing project changes as CMCMM criteria is originally originated from the wide spectrum of opinions and experiences of practitioners that are currently based in Kuwait and involved in the local construction industry.

Since all the case studies achieved the same capability level which is level zero, none of these cases achieved any generic goal. As previously shown, the companies featured in the case studies were not successful to satisfy all the specific goals which is a requirement for GP1.1 thus a prerequisite for achieving GG1. Some generic practices that are required to achieve the second generic goal were successfully conducted in the case studies. Nonetheless, the CMCMM criteria requires achieving competence in GG1 to have a complete change management process first then shift this focus to institutionalising and defining the process to fit the varying project parameters and constraints.

Based on the evaluation of the three companies' capability of change management, it is recommended that an action plan should be set in motion in order to start filling the current gaps in practices. Knowing the gaps without creating an action plan would not actually contribute to the contractor's change management capability. Therefore a systematic and controlled is absolutely essential and as important as the appraisal process itself in order to enhance the contractors ability to manage change and potentially optimise the project outcomes. It is also important for this action plan to set a properly studied deadlines for implementing process changes in addition to having a high degree of commitment towards these deadlines. The deadlines would differ based on the current gaps of each company and based on the necessity of a logistical foundation to actually integrate new change management processes. The companies were ensured that it is possible to reach out for the researcher's support and consultation during the phase of integrating the change management processes in order to facilitate a more efficient and effective integration. Following this recommendation would eventually promote the change management capability of these contracting companies to CL1. Subsequently, the effort would be shifted towards the institutionalisation and full definition of the change management process throughout the organisation as a whole to reach CL2 and CL3.

8.3.7 CMCMM Post-Appraisal Evaluation

After conducting the appraisals, a survey was distributed to all the case study participants to evaluate the validity, practicality and overall value added by the CMCMM components. The output of this questionnaire survey is particularly important as it will indicate the feedback of the first model users and reflect their actual experience throughout the appraisal process. As a result, a total of 31 participants shared their experience concerning the usage of CMCMM and its components. Table 8-13 shows the mean, standard deviation and coefficient of variance for the data collected from the post-appraisal questionnaire.

Table 8-13 Post-appraisal review results comparison with previous expert review results

		PART II					PART III				PART IV					Part V			
		A	B	C	D	E	A	B	C	D	A	B	C	D	E	A	B	C	D
Post-Appraisal (Case Study)	Mean	4.40	4.10	4.20	4.50	4.29	4.13	4.26	3.20	4.29	4.60	4.40	4.23	4.10	4.42	2.81	4.70	4.16	3.58
	Std Dev.	0.89	1.04	0.85	0.50	0.74	0.72	0.89	1.18	0.94	0.60	0.86	0.84	0.82	0.72	1.05	0.40	0.64	0.72
	CV	0.20	0.25	0.20	0.11	0.17	0.17	0.21	0.37	0.22	0.13	0.19	0.20	0.20	0.16	0.37	0.09	0.15	0.20
Domain Experts Evaluation	Mean	4.70	3.40	4.30	4.80	2.40	3.80	4.20	2.80	3.70	4.90	3.80	4.70	4.50					
	Std Dev.	0.48	0.70	0.67	0.42	0.84	0.79	0.42	0.92	1.16	0.32	1.14	0.48	0.53					
	CV	0.10	0.21	0.16	0.09	0.35	0.21	0.10	0.33	0.31	0.06	0.30	0.10	0.12					

The rating of the model after usage by the case study participants was rather positive. Most of the questions received a mean score above 4 thus indicating a high level of agreement on the validity and practicality of different CMCMM aspects. The highest rating was 4.7 which was awarded to the example mentioned in the CMCMM user guide and its contribution to increasing the understanding of utilising the model in the practical setting. The subsequent highest rating was 4.6 which indicates the high degree of clearness of the appraisal cycle in the practical setting and that it is comprehensible in the perspective of the participants who wen through the appraisal.

The lowest ratings were awarded to the amount of improvement representation description clarity, the detail sufficiency of the user guide and the ability of the user guide to be helpful for a user with no prior knowledge of capability maturity models. It was clear that these ratings require further attention to improve the validity and practicality of the model. The degree of consensus was also calculated and was reached for each rating as CV did not exceed the threshold of 50% specified by Dajani *et al.* (1979).

Table 8-12 also compares these results with the previously collected feedback from the domain experts. This should contribute to indicating if the model improvements that were based on the experts review was successful. This comparison is possible since the case study uses the same questionnaire survey tool with few additional questions to allow comparison. Clearly, the survey used in the post-appraisal model evaluation featured new questions which are mostly focused on the utilisation of the CMCMM user guide which is highlighted in grey in Table 8-12 to indicate that these questions were not previously used in the expert review. The formerly implemented review-based enhancements had a clear positive effect on the validity and practicality of CMCMM according to the results comparison. Some of the biggest improvements related to the CMCMM criteria implies that experts have a better perspective regarding the model criteria distinction and description clarity. The experts rating has also improved regarding the improvement representation's clarity, description and support to domain improvement. The appraisal cycle has also received increased rating from the reviewers concerning the practicality of this cycle for the real life setting. Nonetheless, it is vital to consider that the sample number from the compared ratings is drastically different which may not yield a proper basis to judge the effects of the review based improvement. That would be in addition to the participants having different education and experience in the industry.

To further investigate rooms for improving the validity and practicality of the model, the reviewers were asked to provide comments regarding the CMCMM improvement criteria, improvement representation, appraisal cycle, the user guide and the general impression of the model.

Comments regarding CMCMM improvement criteria majorly fixated on the criteria being too progressive, resource demanding and hard to implement within an mean contracting company and there is a need to tailor the model based on the organisation's needs and requirements. A similar point was previously raised by some domain experts prior to the case studies as well. Nonetheless, it is important to commit to these specific practices as they were particularly promoted as value adding and beneficial for an enhanced change management process by practitioners in Kuwait. Even though some of these practices may demand high dedication of resources and training, it should be done for the better good represented by the companies ability to properly manage change when it arises in the project and be able to restrain the detrimental effects of negative changes and take advantage of the positive project changes.

Other comments and suggestions highlighted CMCMM's improvement representation. Some comments focused on the difficulty level of reaching capability level 1 in the model as it is required to perform 52 practices to simply reach the level 1. Since the structure of CMCMM capability levels were built to be similar to the CMMI's improvement representation, CL1 is only achieved after completing all the specific practices and goals thus representing the availability of the full range of practices and tools required for a successful change management process. Another comment pointed out that the capability levels are clear, but there is a need for a bigger figure that connects all the parts of CMCMM together and builds a sense of continuity for properly understanding and using the model.

The next part of the comments highlighted how the appraisal cycle can be improved. Most of the comments were fixated on increasing the efficiency and objectiveness of the data collection process within the appraisal. Various participants suggested the conduct of less interviews and rather investing time in requesting objective documentation such as templates and records to appraise the compliance with the model criteria. It is also essential to use an appraisal team to mainstream the process and get better and faster results as overwhelming one appraiser with the whole organisation may bring counter effects on the appropriateness of conducting the process and the value added by conducting the appraisals as pointed out by several participants. Besides, one participant added that any appraiser should be properly trained, mentored and coached prior conducting the actual appraisal to secure a time effective appraisal process with proper results. The participant further elaborated through mentioning that the best preparation should be through allowing the non-experienced appraiser to attend an actual appraisal process with a more experienced appraisal prior to conducting any appraisals himself/herself.

Comments were also provided to improve the CMCMM user guide. First, a lot of participants praised the guide for its high value in providing assistance for the involved stakeholders. The example mentioned at the end of the guide received an astounding amount of positive comments that proves its effectiveness and fitness for purpose as perceived by the practitioners. Nonetheless, it was pointed out by several participants that the guide needs further detailing to be value adding for new users who have no prior experience or background knowledge regarding capability maturity models. Mentioning more details about the model components, origination and target audience will make this guide comprehensive enough and more user friendly for non-experienced users as one participant suggested.

Comments and suggestions were also requested from the participants regarding their overall impressions and experience with CMCMM. Few participants pointed out that the model is relatively simple even when a user has a limited or no experience in similar models. The guide is a valuable part which shows what the model is made of and an overview of how it works together. A participant underlined that the general lack and weakness of project management culture within the vast majority of contracting companies may represent the biggest barrier of success when using CMCMM. Another participant added that another big challenge is securing the upper management sponsorship as improving the change management process will be resource consuming and needs a huge amount of real dedication in order to be properly implemented within any organisation.

The comments, suggestions and ratings provided by the case studies participants formed a robust basis for improving different aspects of the model. The improvements include the following:

- The specific practices SP2.2 was updated to indicate that the awareness emails should be regarding change management rather than general awareness emails.
- A figure was added to the improvement representation section to illustrate how all the goals and practices are connected to the each capability level.
- A statement was added to the appraisal section that requires the collection of objective evidences when conducting the appraisal.

- Prior auditing experience was added as a prerequisite for any person in charge of being the appraiser.
- A background section was added after the introduction to provide more depth regarding the change management stages and the model development and structure.
- The user guide's targeted audience were specified in the document.

The improvement to CMCMM was correspondent to the ratings and comments of of the post-appraisal evaluation and were all documented as illustrated in Appendix N. These improvements should further enhance the practicality and validity of the CMCMM model.

8.4 SUMMARY

After establishing the change management capability maturity model (CMCMM) in the previous chapter, this chapter shows how the quality and trustworthiness of the model was tested through applying it to real world scenarios and observing the performance, validity and value added by the model. The model application and verification started with an expert review followed by conducting case studies. The first step of evaluating the model was having it reviewed by matter experts in order to gain a critical perspective on the validity of the developed model. These experts possessed knowledge in the subject of project change management and were capable of contributing positively to the verification process. The most important output of the expert review was developing the CMCMM user guide which can be used by the appraiser to understand how the model functions and how to conduct the appraisal itself. Following the domain experts review, the practical setting evaluation took place using the case study approach.

The CMCMM model was used to deeply explore the ability of the three contracting organisations to conduct the change management practices that are necessary within each change management stage. The data collected from the case studies were statistically analysed and indicated the ability of CMCMM to capture the actual change management capability level in the organisation and its degree of practicality based on the three case studies.

Additionally and as a byproduct of this stage, the change management capabilities were indicated for the three case studies and a deeper perspective was provided about the current situation of change management processes in Kuwait. The three case studies achieved a capability level 0 which shows the lack of application for the full range of processes required for a successful change management process in the contracting organisation. It was clear that the three case studies did not reach capability level 1 as some specific practices were missing thus preventing the completion of all the specific goals. The post-appraisal interviews showed improvement in the model's usability, practicality and fitness for purpose when compared to the feedback received from the expert panel. The main reason is that the model was also refined in multiple aspects according to the constructive feedback received from the matter experts prior to conducting the case study. The post-appraisal interviews also contributed to further improve the model and the user guide in order to facilitate a more clear and smooth appraisal process and better implementation of the CMCMM model.

CHAPTER 9 - CONCLUSION AND RECOMMENDATIONS

9.1 INTRODUCTION

This chapter demonstrates the results and achievements of this research with regards to the aim and objectives that were declared from the launch of this thesis. Moreover, this chapter also stipulates the research's contribution to the body of knowledge and the practical implications of this research. Finally, the limitations of this research are discussed and recommendations towards conducting further studies are presented at the end of this chapter.

9.2 ACHIEVEMENT OF RESEARCH OBJECTIVES

This research had the aim of thoroughly investigating and developing a capability maturity model that can evaluate the change management capability of contractors, with specific focus on contractors in Kuwait. This aim was pursued through achieving particular research objectives:

1. To explore theoretical concepts and previous work on project changes and change management in construction with specific focus on contractors,
2. To evaluate the existing change management practice in Kuwait from a contractors' perspective,
3. To identify key factors that indicate the ability of contractors in handling project change,
4. To develop a Change Management Capability Maturity Model (CMCMM) for assessing the change management position of contractors and their capabilities,
5. To validate and verify the application of CMCMM through using the expert review and case study research methods.

The following section outlines the key findings with respect to the research objectives.

Objective 1: To explore theoretical concepts and previous work on project changes and change management in construction with specific focus on contractors.

The literature review thoroughly investigated changes that may occur in projects within the context of the construction industry. As a result, this literature review entailed the examination of project change dimensions including time, need, effect, process and environment in addition to the association and connectivity of these dimensions. The literature review also discussed the numerous project change causes and its classification including external and internal in addition to reviewing other types of change causes classifications. The literature review similarly discussed the change effects of detrimental, beneficial and neutral changes when encountered in a project. In addition to the literature review giving a special emphasis for project changes in the Kuwaiti construction industry and the frequent causes and effects of these changes.

Next, the literature review covered the different approaches of process-based change management. Change management contained five (5) dimensions including people, process, tools, methodologies and finally results and outcomes. The process dimension acts as an overarching mean to successfully manage project changes and enhance the ability of the project team to manage project changes as evident in the reviewed literature.

The literature review also examined the different capability maturity models developed for assessing process capabilities. Next, the literature review focused on the mechanism and operation routes of Capability Maturity Models (CMMs). A specific focus was given to the CMMI which is one of the most important and frequently used models according to the previous literature review. The structure of CMMI was extensively reviewed and appraised against other CMMs found in the literature. The model improvement criteria, improvement representation and appraisal method were highlighted to clarify how the model functions.

CMMs developed for the change management domain were also reviewed intently in the literature review to find the gaps in the current body of knowledge. Several gaps were perceived to exist in the knowledge concerning the change management domain. The gaps were related to different elements in the currently established change management CMMs such as unclear model structure, weak development phases of the model components and overall lack of validity verification. These gaps include the lack of focus on a specific phase of the process within the model which could contribute to creating a more robust model that is oriented towards the needs of the specific phase. Change management related CMMs do not indicate how different practicers have varying significance which should be reflected in the model improvement criteria itself to emphasise the importance of a specific practice. Therefore, it is clear that a proper change management maturity model that is properly structured and robustly constructed is missing the literature.

Objective 2: To evaluate the existing change management practice in Kuwait from a contractors' perspective.

Evaluating the existing change management practices in Kuwait started with expanding the practices found in the literature through conducting preliminary interviews with five practitioners in the Kuwaiti construction industry. After conducting a qualitative analysis, the interviews contributed to enhancing the list of change management practices that were extracted from the previous literature review. These practices were classified into the main stages of the change management process including promoting a balanced change culture, identifying change, evaluating change, implementing and monitoring change and continuous improvement.

Consequently, a pilot survey was conducted to test the questionnaire which was set for the purpose of validating the significance of the comprehensive list of change management practices and tools from the perspectives of the contractors in Kuwait. When the pilot survey proved successful, the full survey took place with the participation of 112 industry professionals in Kuwait and yielded results that were quantitatively analysed to indicate 52 potentially successful change management practices and tools that can be used in each change management stage. Accordingly, these practices were incorporated in constructing the improvement criteria of the change management capability maturity model. Therefore, this survey ultimately assured that the created model is suitable and even tailored to be used by contractors in Kuwait in order to enhance their ability to manage project change.

Objective 3: To identify key factors that indicate the ability of contractors in handling project change.

Following the results yielded from the survey, the model was ready to be constructed as the main evaluation criteria was already detected. Nonetheless, the model aimed to indicate the difference in significance between different processes within the same change management stage in order to properly indicate the capability of the contractor to manage change at different stages. First, the principal component analysis (PCA) technique was used as a dimension reduction technique of the successful change management practices and tools in order to create proper and coherent groups for the processes and yield proper results for the significance of each process by using the Analytic Hierarchy Process (AHP). Therefore, Based on the analysis results, twelve different dimensions were concluded to fully represent these practices and tools. After the dimension reduction process, the Analytic Hierarchy Process (AHP) process was used to compare between the change management practices and tools. An expert panel of eight participants (from both industry and academia) were consulted for the purpose of assigning weights to the criteria within twelve different matrices to reflect their relative significance. The Delphi technique was used in conjunction with the AHP process and was one additional Delphi round was conducted to assure that consensus was reached to an acceptable degree between the experts and the individual consistency ratio of each respondent reached an acceptable reliability level.

Objective 4: To develop a Change Management Capability Maturity Model (CMCMM) for assessing the change management position of contractors and their capabilities.

Chapter 7 featured the creation of the initial version of the Change Management Capability Maturity Model (CMCMM) based on the conducted literature review, questionnaire survey and AHP results. CMCMM is a specific-domain capability maturity model which adopted the continuous improvement representation in order to accurately indicate the capability of the contractor to mange change in the five different stages which are promoting a balanced change environment, identifying change, evaluating change, implementing and monitoring change and finally continuous improvement. The continuous improvement representation allows CMCMM to focus on a specific domain (change management) rather than focusing on the overall organisational performance which is not the main objective of the model. This choice was synonymous to the using

Capability Levels (CL's) to indicate how far the organisation has gone in the road to successful change management process capability.

The created CMCMM model included fifty-two specific practices which were concluded from the questionnaire survey which were used as the improvement criteria. These practices were grouped under twelve specific goals using the Principal Components Analysis (PCA) technique. The weights concluded from the AHP process were assigned to the specific practices of each change management stage in order to indicate the varying importance of different processes within the same change management stage. Similar to the CMMI, a specific goal is considered achieved when all the underlying practices are complete and properly used in the organisation. Therefore, the twelve principal components concluded earlier were seen as specific goals in CMCMM as achieving competence in the underlying practices would resemble the completeness of the principal component itself. When it comes to the appraisal process itself, CMCMM employs the SCAMPI appraisal phases that are defined in the Appraisal Requirements for CMMI (ARC) consisting the three stages of planning, appraisal and finally analysis and reporting. This model should model should be capable of indicating the flaws in the current change management practice conducted by contractors in Kuwait. These flaws can be improved in order for the contractor to properly manage change in the five stages and eventually secure better project outcomes.

Objective 5: To validate and verify the application of CMCMM through using the expert review and case study research methods.

After establishing the change management capability maturity model (CMCMM), chapter 8 showed how the quality and trustworthiness of the model was tested through applying it to real world scenarios and observing the performance, validity and value added by the model. The model application and verification started with an expert review followed by conducting case studies.

The first step of evaluating the model was having it reviewed by ten matter experts in order to gain a critical perspective on the validity of the developed model. These experts possessed knowledge in the subject of project change management and were capable of contributing positively to the verification process. Such experts were routed either to the industry or to academia with research related to the construction project management domain. This combination of both sectors collectively provided constructive criticism and feedback about the practicality, reliability and fitness for use of CMCMM. The biggest output of the expert review was creating the CMCMM user guide which can be used by the appraiser to understand how the model functions and how to conduct the appraisal itself.

Following the domain experts review, the practical setting evaluation took place using the case study approach. The outcome of the practical setting evaluation contributed to improving the capability maturity model itself and the evaluation process. The CMCMM model was used to deeply explore the ability of the three contracting organisations to conduct the change management practices that are necessary within each change management stage. The data collected from the case studies were statistically analysed and indicated the ability of CMCMM to capture the actual change management capability level in the organisation and its degree of practicality.

A questionnaire survey was given to the thirty-one respondents who participated in the case study to indicate their feedback about the practicality and validity of the CMCMM components and the model's overall fitness for purpose. As a result, Minor amendments were introduced to optimise CMCMM for enhanced usage and practical. CMCMM's components and user guide were refined based on the received constructive criticism based on feedback regarding the actual application of the model. Additionally and as a byproduct of this stage, the change management capabilities were indicated for the three case studies and a deeper perspective was provided about the current situation of change management processes in Kuwait.

The three case studies achieved a capability level 0 which shows the lack of application for the full range of processes required for a successful change management process in the contracting organisation.The post-appraisal interviews showed improvement in the model's usability, practicality and fitness for purpose when compared to the feedback received from the expert panel. The main reason is that the model was also refined in multiple aspects according to the constructive feedback received from the matter experts prior to conducting the case study. The post-appraisal interviews also contributed to further improve the model and the user guide in order to facilitate a more clear and smooth appraisal process and better implementation of the CMCMM model. It is safe to say that the model was thoroughly validated through this stage and can be used in a wider scale amongst contractors in Kuwait.

9.3 CONCLUSIONS AND IMPLICATIONS OF THE STUDY

This is the first comprehensive research that fixated on extracting, validating and grouping the successful criteria of change management for contractors in Kuwait. The research successfully identified 52 criteria that would contribute to a proper change management for contractors and a capability maturity model that would assess the capability of the contractor in managing project change. The successful criteria represented by the change management practices and tools were categorised against the five change management stages as following:

- Promoting a balanced change culture:
    - Assign change management roles
    - Sponsor and support the culture of change
    - Dedicate change management training, resources and funding
    - Share knowledge and experience through change logs of previous projects and/or shared databases
    - Audit team's preparedness for change
    - Use standard forms and documentation in promoting a balanced change culture
    - Review the feasibility of the project requirements and variation clauses prior to signing the contract
    - Circulate awareness emails
    - Share knowledge and experience through informal discussions
    - Share knowledge and experience through formal meetings
    - Encourage transparency and communication amongst team members
- Identifying change:
    - Compare actual cost and quantities with approved BOQ
    - Compare actual quality with the contract requirements and specifications
    - Compare actual project progress with the project schedule
    - Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)
    - Communicate when a change occurs (verbally and/or writing)

- Use photos and/or videos for reporting the worksite related changes
- Use change prediction tools
- Use a database to identify potential change(s)
- Use root cause analysis to understand the main trigger(s) of the change
- Use value management to identify positive change(s)
- Use Building Information Modelling (BIM) for change identification
- Use standard forms and documentation in identifying change

● Evaluating change:

- Use a change log
- Use records management
- Use earned value methods
- Use root cause analysis
- Use standard forms and documentation in evaluating change
- Use risk analysis to understand risk implications
- Use change predicting system using activity-based dependency structure matrix (DSM)
- Use productivity oriented analysis for design revisions
- Use knowledge-based decision support system (KBDSS)
- Request the experts of the subcontractor, supplier or the design consultant if needed
- Use Microsoft Excel to evaluate quantity and/or cost changes
- Use scheduling software to evaluate schedule related changes

● Implementing and monitoring change

- Monitor implemented change and report on a daily, weekly or monthly basis
- Use phones, messages and emails to provide updates about the change
- Use Microsoft Word and/or Microsoft Excel to monitor change
- Gain formal client approval prior to change implementation

- Implement minor changes that would not affect project parameters and requirements without client approval
- Use a change log
- Use a content management system (CMS) for communication
- Use Building Information Modelling (BIM)
- Use standard forms and documentation for implementing and monitoring change

- Continuous Improvement
    - Share experiences through informal discussions
    - Encourage professional development related to change management
    - Encourage self-driven knowledge and skills enhancement
    - Benchmark the process outcomes
    - Use a content management system (CMS) for storing and sharing lesson learned
    - Share experiences through project close out meeting
    - Use, update and maintain a change log
    - Use standard forms and documentation in continuously improving from lessons learned
    - Perform Specific Practices
    - Establish an Organisational Policy
    - Plan the Process
    - Provide Resources
    - Assign Responsibility
    - Train People
    - Control work products
    - Identify and Involve Relevant Stakeholders
    - Monitor and control the process
    - Objectively Evaluate Adherence

- Review Status with Higher Level Management
- Establish a Defined Process
- Collect Process Related Experiences

The model used to evaluate the capability of contractors to manage project change, named the Change Management Capability Maturity Model (CMCMM), guidance and appraisal cycle were presented in Chapter 7. CMCMM was successfully used to evaluate the capability of three contracting companies to manage change. This evaluation was conducted according to the ARC process and utilised the CMCMM user guide. It can be concluded that CMCMM is ready for further implementation in other contracting companies as it is fully capable of setting the path for improvement which is tailored for contractors in Kuwait.

It is clear that there are major gaps in the current change management practice of contractors in Kuwait as none of the case studies were able to achieve CL1. In other words, none of these contracting companies were actually implementing change management to its full capacity thus cannot expect to have an optimum outcome when managing project change. The model and the user guide was also evaluated itself and improved from the feedback of the matter experts and the case studies in order to ensure that the implementation of this model would be as straight-forward and user friendly as potentially possible.

The following section demonstrates how this research contributed to the body of knowledge related to the construction management domain and had positive practical implications for the Kuwaiti construction industry after attaining the research objectives.

9.3.1 Contribution to knowledge

This research provides several contributions related to the knowledge in the construction management domain and specifically project change management.

The research provides a comprehensive path in developing an empirically based capability maturity model. For a matter of fact, CMCMM is the only empirically based capability maturity model that is constructed to evaluate and improve the contractor's capacity to manage project change. The research also shows how a new CMM can be built on the basis of well-established models such as the CMMI. In other words, CMCMM contained specific practices and goals which were developed particularly for the change management domain while the generic practices and goals were directly used as presented in the CMMI since the aim of these generic practices and goals is the generalisation and improvement of the process regardless of the domain of application. CMCMM uses both generic and specific practices and goals seamlessly and coherently in a way that can inspire the development of other capability maturity model targeting other domains on the same basis.

Additionally, the CMCMM evaluation criteria are categorised within the five management stages which is also unprecedented by any other capability maturity model available in the literature. This would provide the added value of evaluating and recognising the gaps in practice within each of the five change management stages. The evaluation criteria were also assigned weights that reflect their relevant value in successfully managing change within a construction project. This makes CMCMM the only change management capability maturity model able to accurately indicate the progress of capability progress depending on the satisfied criteria rather than providing course results that impede deep interpretation of the process gaps in the organisation. None of the existing change management capability maturity models in the literature specified weights to the improvement criteria and as a result failed to take into consideration the true significance of each process on the contractor's ability to manage change.

This research also featured the development of a user guide that was used to facilitate the usage of CMCMM. As of this date, there is not one capability maturity model presented in the literature that was accompanied by a step-by-step user guide such as the one developed for CMCMM. Evidently, the case studies show that the guide was deemed remarkably handy by the industry professionals through providing sufficient background information about the change management domain, capability maturity models, CMCMM components, appraisal cycle and an explanatory illustration of how the model would be used in the practical setting. The guide also features an example to illustrate how CMCMM would be used in the real appraisal and what the results would look like.

The high degree of transparency and clarity of the model's development process may also contribute to future research to the contrary of the other CMM's addressing change management that were developed through vague and unclear procedures. For instance, the other models in the literature do not specify how the model's evaluation criteria was developed and the basis of such a fundamental decision.

9.3.2 Practical implications

The 52 change management criteria and the CMCMM provides an amplified insight into managing project changes successfully within a construction project for industry practitioners in contracting organisations. Other stakeholders who would have potential interest in the research output are government agencies, public and private clients, professional association of engineers. The governmental or private entities can also potentially use CMCMM as a reference model for a selection criteria that determines the contractor's preparedness to manage project changes. Using CMCMM by the client could be used for performance evaluation of contractors who are handling current projects as an assurance of the contractor's resilience and ability to integrate different types of change which could incidentally be value adding for the client's business.

Since the case studies were carried out with three contracting companies in Kuwait with different categorisation as per the Central Tenders Committee (CTC), this implies the compliance of CMCMM with a wide range of different contractor companies sizes, project specialization and capital. Therefore, this research provides contractors with an implementation baseline for successfully managing project change through different stages and a tool to clearly evaluate their current standing in the change management capability. Following the appraisal cycle and using the supplementary components of the model would enable the contractor to build a solid foundation that ensures a successful and ever improving process which supports a favourable outcome for the contractor.

9.4 LIMITATIONS OF THE RESEARCH

This research had certain limitations as is the case for all studies.

1. The 52 criteria which were concluded from this research which are necessary for a successful change management process were throughly developed and validated through consulting practitioners and matter experts in Kuwait. These criteria need to be validated for usage in other countries other than the Kuwaiti construction industry or the risk would be that the criteria would not properly serve the expected adequacy of managing project change. The necessity for optimisation is also represented by having some contracting companies based in Kuwait yet involved in projects in other countries as well.
2. Due to limited access for documentation, the appraisal process of the case studies were solely based on the verbal confirmation of the participants. Further communication was required in case of inconsistent responses regarding a practice. In order to provide a more accurate and time efficient process, objective documentation should be used when the model is applied in reality thus indicating a more accurate change management capability level.
3. The case studies featured three different contracting companies that are categorised in three different classifications according to the Central Tenders Committee of Kuwait. Nonetheless, there was not enough data to support any differing implementations of change management practices according to the contracting company categorisation. Studying these differences may call for the development of several CMCMM versions that are customised per the contracting company category.
4. The case studies portrayed the implementation of the model in three different organisations with the purpose of clarifying the gaps in practices related to change management. The research scope did not follow through to see how these missing practices were mentioned in an action plan and implemented in the organisation. Monitoring this process would provide further input to the perspective of implementing the model and potentially further detail the used appraisal cycle.

9.5 RECOMMENDATIONS FOR FURTHER STUDY

This research has deeply explored change management as a process for contractors to optimise the project outcomes for their organisations and clients. Subsequently the research developed a model with the sole purpose of evaluating the change management readiness of contractors in Kuwait and potentially if validated, contractors based in other regions as well. During the phases of this research, various areas carries potential for future investigation and research. The potential research topics are listed below.

- To implement CMCMM in a different country where local practitioners would contribute to the tailoring of the model criteria. This would assure that CMCMM is fit for its purpose within the studied country and allow for comparing the state of change management practices in different regions as the applicability of CMCMM in construction industries other than the Kuwaiti construction industry remains open for investigation and further study in order to gain a definitive confirmation of model alignment with the other industries.
- To assess the usage of CMCMM in other project-based industries such as the IT industry and optimise the model accordingly. The model could be potentially tailored to fit the constraints and conditions of the hosting industry.
- To develop a national benchmark for change management using CMCMM. In which case the contractor would refer to this benchmark and use the model to assess the organisations ability to manage project changes to an adequate level. This benchmark could also be used for selecting contractors prior to signing the construction project contract and ensure a suitable level of resilience would be present within the contracting company.
- To study the output of conducting an appraisal throughout the organisation on the basis of objective and tangible information of documentation for further validation of results.
- Study how the contractors' different categorisation in CTC influences the presence or absence of practices in general and within each stage and develop a model that can be tailored based on the contractor category.
- Observe how the implementation of previously missing change management practices and tools provide the contractor with tangible improvements and optimised project outcomes.

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APPENDIX A

This appendix shows the different categorisations of change causes that were discovered in the literature.

Generic Categories					Specific Categories							
Love et al. (2002)	Erdogan et al. (2005)	Wang et al. (2012)	Kerzner (2001)	Aven (2014)	Sun et al. (2009)	Assaf & Hejji (2006)	Chang et al. (2011)	Alnuaimi et al. (2010)	Arain and Low (2006)	Enshassi et al. (2010)	Wambeke et al. (2011)	Ochoa (2014)
Internal factors	Internal factors	Internal factors	Internal factors/ Common causes	Internal factors/ Common causes							Pre-requisite works	
					Project related	Project related						
					Client related	Client related	Client related	Client related	Client related	Client related		
					Contractor related	Contractor related		Contractor related	Contractor related	Contractor related		
					Design related	Design related	Design related				Detailed Design related/working method	Design/Submittals related
								Consultant related	Consultant related	Consultant related		
						Materials related					Materials/component related	Materials related
						Equipment related					Tools/Equipment related	Equipment related
						Labor related					Labor related	Labor related
										Donor related		
											Work/Job site conditions	Work/Job site conditions
											Management/ supervision/ information flow	Management/ supervision/ information flow
												Transportation related
External factors	External factors	External factors	External factors / Special causes	External factors / Special causes	External factors	External factors	External factors	External factors	External factors	External factors	External factors/ weather	

APPENDIX B

This appendix shows the different change causes that were discovered in the literature. These change causes were also sorted within lower level and high level groupings for clarification.

High level Grouping	Lower Level Grouping	Change Cause	Source
Internal	**Pre-requisite works related**	Non-complete previous connected work Lack of quality in previous work causing rework minor lack of quality in previous work (no rework needed) Inspections for previously completed work	Wambeke *et al.* (2011)
Internal	**Client related**	New requirements by client (addition & omission of work scope)	Chan and Kumaraswamy (1997) Wu *et al.* (2004) Assaf & Hejji (2006) Chang *et al.* (2011) Alnuaimi *et al.* (2010) Arain and Low (2006) Enshassi *et al.* (2010) Aldubaisi *et al.* (2000)
		Decision making lacks adequate speed	Assaf & Hejji (2006) Alnuaimi *et al.* (2010) Arain and Low (2006) Enshassi *et al.* (2010)
		Contract duration imposed by the client is unrealistic	Chan and Kumaraswamy (1997) Chang *et al.* (2011)
		Client financial issues	Assaf & Hejji (2006) Arain and Low (2006) Enshassi *et al.* (2010)
		Changes in project specifications by client	Alnuaimi *et al.* (2010) Arain and Low (2006) Enshassi *et al.* (2010)
		Incomplete or incorrect information such as project objectives by client	Chang et al. (2011) Arain and Low (2006) Enshassi *et al.* (2010)
		Schedule changes by client	Arain and Low (2006) Enshassi *et al.* (2010)

		Replacement of materials or procedures	Arain and Low (2006) Enshassi *et al.* (2010)
		Inflexible client	Arain and Low (2006) Enshassi *et al.* (2010)
		Site accessibility delay by client Delays in approving and revising of design documents by client Delays in approving shop drawings by client Delays in approving materials by client Lack of communication between stakeholders Conflicts between joint-ownership of the project Unavailability of incentives for contractor in order to complete the work ahead of schedule	Assaf & Hejji (2006)
		Influence of other units associated to the client	Chang *et al.* (2011)
		Land allocation problems Inadequate experience of owner's staff	Enshassi *et al.* (2010)
		Inadequate planning and scheduling by contractor	Chan and Kumaraswamy (1997) Hsieh *et al*. (2004) Wu et al. (2004) Assaf & Hejji (2006) Alnuaimi *et al.* (2010) Arain and Low (2006)
		Inadequate site supervision Inadequate site management	Chan and Kumaraswamy (1997) Assaf & Hejji (2006) Alnuaimi *et al.* (2010)
		Inadequate contractor experience	Chan and Kumaraswamy (1997) Assaf & Hejji (2006) Alnuaimi *et al.* (2010) Arain and Low (2006)
		Delays in subcontractors work	Chan and Kumaraswamy (1997) Assaf & Hejji (2006) Alnuaimi *et al.* (2010)

Internal	**Contractor related**	Inadequate Labour	Wu et al. (2004) Arain and Low (2006)
		Difficulties in financing project by contractor Poor communication and coordination by contractor	Assaf & Hejji (2006) Arain and Low (2006)
		Differing site conditions Lack of local conditions awareness by contractor	Arain and Low (2006) Enshassi *et al.* (2010)
		Inadequate skills of contractor's construction manager	Chan and Kumaraswamy (1997) Arain and Low (2006) Enshassi *et al.* (2010)
		Inadequate managerial skills Improper control over site resource allocation Unsuitable management structure and style of contractor	Chan and Kumaraswamy (1997)
		Conflicts in sub-contractors schedule in execution of project Rework due to errors during construction Conflicts between contractor and client or consultant Improper construction methods implemented by contractor Inadequate contractor's work Frequent change of sub-contractors because of their inefficient work Delay in site mobilisation	Assaf & Hejji (2006)
		General contract conditions have grey areas allowing contractor to request variations Contractor misuses variation instructions	Alnuaimi *et al.* (2010)
		Lack of equipment Profitability requirements by contractor Fast track construction Design complexity Technological complexity Contractor's stubborn nature Unavailability of specific data for the contractor	Arain and Low (2006)

Internal	**Design related**	Errors and conflicts in design documents	Chan and Kumaraswamy (1997) Hsieh *et al*. (2004) Assaf & Hejji (2006) Chang *et al.* (2011) Wambeke *et al.*(2011) Ochoa (2014)
		Inconsistency between drawings and site conditions	Hsieh et al. (2004) Wu *et al.* (2004)
		Delay in design information	Chan and Kumaraswamy (1997) Assaf & Hejji (2006) Wambeke *et al.* (2011)
		Unclear and inadequate design information	Wu *et al.* (2004) Assaf & Hejji (2006) Wambeke *et al.* (2011)
		Inadequate design team experience	Chan and Kumaraswamy (1997) Chang *et al.* (2011) Assaf & Hejji (2006)
		Project design complexity	Assaf & Hejji (2006) Wambeke *et al.* (2011) Chan and Kumaraswamy (1997) Hsieh *et al.* (2004)
		Design changes	Hsieh *et al*. (2004) Ochoa (2014) Lee and Pena-Mora (2007)
		Necessary variations of works Slow drawings approval process	Chan and Kumaraswamy (1997)
		Improper planning Errors in quantity estimations Omissions in quantity estimations Citation of inadequate specification	Hsieh *et al*. (2004)
		Misunderstanding of owner's requirements by design engineer inadequate engineering software usage by the designing team	Assaf & Hejji (2006)

		Lack of co-ordination by designer Designer overloaded with work tasks	Chang *et al.* (2011)
		Low design constructibility Strict specification requirements Quality control requirements Work sequence or method is not well planned Repeatability of design is inadequate	Wambeke *et al.* (2011)
Internal	**Consultant related**	Lack of consultant experience and familiarity with the regulations and construction permits Inadequate design performance by consultant	Alnuaimi *et al.* (2010) Arain and Low (2006) Enshassi *et al.* (2010)
		Change in design by consultant Conflicts between contract documents Lack of coordination Lack of consultant's knowledge of available materials and equipment	Arain and Low (2006) Enshassi *et al.* (2010)
		Inadequate experience by consultant's supervisors Inadequate supervision by consultant	Alnuaimi *et al.* (2010)

		Conflicts between contract documents Inadequate scope of work for contractor Technology change Value engineering Design complexity Inadequate working drawing details Inadequate shop drawing details Unavailability of specific data for the contractor Stubborn nature of consultant Ambiguous design details Design discrepancies Design is not compliant with government regulations Design is not compliant with owner's requirement Change in specifications by consultant	Arain and Low (2006)
Internal	**Materials related**	Delay in material delivery	Assaf & Hejji (2006) Wambeke *et al.* (2011) Ochoa (2014) Wu *et al.* (2004)
		Shortage of construction materials in market	Assaf & Hejji (2006) Ochoa (2014)
		Noncompliance with material requirements Material need to be in the right place when needed	Wambeke *et al.* (2011) Ochoa (2014)
		Changes in material types and specifications during construction	Assaf & Hejji (2006) Aldubaisi *et al.* (2000)

		Damage of sorted material while they are needed urgently Delay in manufacturing special building materials Late procurement of materials Late in selection of finishing materials due to availability of many types in market	Assaf & Hejji (2006)
		Trying to get consumables	Wambeke *et al.* (2011)
Internal	**Tools/ Equipment related**	Shortage of equipment	Assaf & Hejji (2006) Wambeke *et al.* (2011) Wu *et al.* (2004)
		Equipment breakdowns Low level of equipment-operator's skill Low productivity and efficiency of equipment Lack of high-technology mechanical equipment	Assaf & Hejji (2006)
		Personnel lift (unavailable, no operator, not the priority, maintenance) Power tools (not trained, used by someone else, misplaced, maintenance) Crane or forklift (unavailable, no operator, not the priority, maintenance) Hand tools (used by someone else, misplaced, maintenance) Other heavy equipment (e.g., backhoe, loader, dump truck) not available Personal protective equipment (PPE) (not enough, used by someone else, misplaced, unserviceable)	Wambeke *et al.* (2011)
		Improper selection of equipment	Ochoa (2014)

Internal	**Labour related**	Shortage of labour Unqualified workforce Low productivity level of labour	Ochoa (2014) Assaf & Hejji (2006) Wambeke *et al.* (2011)
		Socialising with fellow workers Constant absence People arriving late and/or leaving early because of illness, injury, family or personal reason Low morale and/or lack of motivation Getting moved to another job/task before the one you were working on was completed Inefficiencies associated with personnel turnover (i.e., new employees) Language barrier among workers and/or worker-supervisor	Wambeke *et al.* (2011)
		Nationality of labour Personal conflicts among labour	Assaf & Hejji (2006)
Internal	**Donor related**	Financial capability of donor Budget allocated constraints Time constraint Interference of donor in project requirements	Enshassi *et al.* (2010)
Internal	**Work/Job site related**	Work site congestion Difficult access to work area Site layout (excessive distance between material storage and required location of work)	Wambeke *et al.* (2011) Ochoa (2014) Wu *et al.* (2004)
		Differing site conditions Safety measurements are required	Ochoa (2014) Hsieh *et al.* (2004)
		Site security considerations	Hsieh *et al.* (2004) Wu *et al.* (2004)

Internal	**Management/ supervision/ information flow related**	Poor leadership by management Inadequate skills by management Inadequacy and unpredictability of decision making	Ochoa (2014)
		Goals and values alterations Technical system alterations Organisational structure alterations Management philosophy alterations Psychological system alterations managerial system alterations Organisational culture alterations System of internal power and control alterations uncertainties in the contract uncertain durations for activities uncertain costs uncertain technical complexities	Love *et al.* (2002)
		Contract duration not suitable for the project Unclear definition of substantial project completion Inadequate project delay penalties Construction contract type (traditional, design & build, …etc) Basis of tender award (reputation, quality, cost, …etc)	Assaf & Hejji (2006)

		Providing information about the design or drawing is slow Lack of supervisor guidance and instructions Lack of field manager (foreman) skill/knowledge Lack of coordination between different trades Unrealistic commitments due to tight work schedule Lack of foreman availability Scope of work alteration Lack of communication skills by foreman Lack of communication between client/engineer and project manager Lack of communication between project manager and foreman	Wambeke *et al.* (2011)
		Decision making lacks adequate speed Lack of communication between stakeholders Information flow between team members lacks adequate speed Structure connecting design teams is incompatible Conflicts between stakeholders Disputes between stakeholders	Chan and Kumaraswamy (1997)
		Disputes between stakeholders	Chan and Kumaraswamy (1997) Assaf & Hejji (2006)
Internal	**Transportation related**	Horizontal transportation Vertical transportation	Ochoa (2014)

External	**External**	Unforeseen site conditions Change of decision-making authority Unpredictable weather conditions Legislative or policy changes Political pressure Natural disaster Expected geological conditions Local residents Other organisations influence Effects of subsurface conditions Delay in obtaining permits from municipality Unavailability of utilities in site (such as, water, electricity, telephone, etc.) Effect of social and cultural factors Traffic control and restriction at job site Accident during construction Safety considerations Changes in government regulations and laws Delay in providing services from utilities (such as water, electricity) Economical conditions	Love *et al.* (2002) Erdogan *et al.* (2005) Wang *et al.* (2012) Kerzner (2013) Aven (2014) Sun *et al.* (2009) Assaf & Hejji (2006) Chang *et al.* (2011) Alnuaimi *et al.* (2010) Arain and Low (2006) Enshassi *et al.* (2010) Wambeke *et al.* (2011) Ochoa (2014)

APPENDIX C

STUDENT SURNAME or PROJECT NO: Abdullah Mughrabi

HERIOT-WATT UNIVERSITY

APPLICATION TO SCHOOL ETHICS COMMITTEE FOR ETHICAL APPROVAL FOR A RESEARCH PROJECT

Click on the grey boxes to insert text

Section A: Project Overview

1. Project Title: CHANGE MANAGEMENT CAPABILITY MATURITY MODEL FOR CONTRACTORS IN THE KUWAITI CONSTRUCTION INDUSTRY.

2. Approval sought: Full approval ☐ Re-Submission ☐ In principle ☐
If 'In principle', when will full approval be sought?

Contact Information

3. Responsible Staff Member / Supervisor of student research:

   a) Name: Prof. Ming Sun

   b) Telephone

   c) Email: M.sun@hw.ac.uk

4. Investigator (if different from Responsible Staff Member) / Student:

   a) Name: Abdullah Mughrabi..

   b) Telephone ....

   c) Email: aom30@hw.ac.uk ....

5. Duration of Proposed: Project 12 months remaining

6. Anticipated Start Date: October 2017

7. Does the proposed research involve human participants or living animals in any way? Yes ☐ No ☐

   Note: Involvement of human participants includes obtaining information from people through methods such as experiments, observation, surveys or interview, or any use of previously obtained personal data, or any use of human tissue samples.

   If your answer to Question 7 is 'yes' complete the rest of the form; if it is 'no', simply sign the declaration in section F at the end of the form.

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8. Please provide a brief summary of the proposed study (if possible, in less than 300 words. Include an overview of the design, variables, and other ethically-pertinent considerations). Feel free to attach a document if convenient.

The research has yet to include interviews and case studies that involves the participation of industry professionals (contractors or employees of contracting companies) and experienced academics. This is required for the creation and validation of the change management capability maturity model (CMCM2). More specific details are featured in the minor report that was previously submitted.

Section B: Administration

		Yes	No
1.	Will participants be appropriately informed of: the aims of the study; their ethical rights; their expected contribution; and their subsequent debrief? For example, their right to withdraw, any deception employed or potential consequences of the study.	☐	☐
2.	Will consent be obtained from all appropriate parties?	☐	☐
3.	Will the Heriot-Watt University Code of Practice governing recruitment of research participants be followed? (Code of Practice available at **Code of Practice governing recruitment of research participants**)	☐	☐

Section C: Ethical Considerations

		Yes	No
1.	Will the study require participants to potentially experience stressful or unpleasant situations?	☐	☐
2.	Will the data collection and management (storage & disposal) potentially compromise the interests of the participants? For example, body fluids, tissue samples or other personally identifiable materials, such as, visual, auditory or other data?	☐	☐
3.	Will payment or non-payment of participants have potentially negative implications in the study?	☐	☐
4.	Are there potential negative outcomes from the study for the participant? For example, compromise to or damage of, their physical, psychological, financial or social wellbeing.	☐	☐
5.	Are there any other potential negative outcomes from the study? For example, damage to property or risk of criminal or civil liability.	☐	☐
6.	Would you identify any other issues that may have potential ethical implications for your study?	☐	☐

If you responded 'No' to any questions in section B, or 'Yes' to any questions in section C, please now complete section D & E. Otherwise, proceed to section F.

Section D: Further Information Regarding Ethical Considerations

If you responded 'No' to any questions in section B, or 'Yes' to any questions in Section C, please provide further information, indicating how you would address this issue. Please be as comprehensive as possible, as this will speed the process for the referees and may avoid the need to contact you for further information or clarification.

Section E: Potential Referees (Optional)

If you have completed Section D, this form and any appended information will be reviewed by the full EGIS Ethics Sub-committee. In addition, if you think it may be helpful for the review, you can suggest up to two staff members with appropriate expertise to review the submission.

1. Name .... Contact...

2. Name .... Contact...

Section F: DECLARATION

The information in this form is accurate to the best of my knowledge

Signature of Responsible Staff Member (PI or research supervisor) Ming Sun ....

Date 3/10/2017...................

Signature of Student (if applicable) ***Eng. Abdullah Mughrabi***

Date: October 02, 2017

Once completed this form should be returned to the Research & Knowledge Exchange Team egis-research-admin@hw.ac.uk. If the form is completed for PGR student research, it must be returned to egis-pgr-students@hw.ac.uk. If the form is completed for MSc/MRes student research, it must be returned to the Learning & Teaching Team egis-pgt@hw.ac.uk.

APPROVAL OF SECTIONS A.8, B, C & D (if completed)

I am satisfied that the researcher has properly considered the ethical implications of the intended study and has taken the appropriate action.

(Chair of EGIS Ethics Sub-committee or delegated representative)...

Date ....23/11/17..................

FINAL APPROVAL

I am satisfied that the researcher has properly considered the ethical implications of the intended study and has taken the appropriate action.

(Head of School / Director of Research)...

Date......................1/12/2017.........

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APPENDIX D

This appendix shows the preliminary interview questions in order to explore the scope of the change management process amongst contractors in Kuwait.

<u>PART I - Interviewee Background</u>

-What is your role in your organisation?

-What is the number of years of experience do you have in the construction industry?

-What is the category of the contracting company you are working with?

-What types of projects is your organisation involved in?

-What is the number of employees in your organisation?

-How long has your organisation been functioning in the construction industry?

-How does your organisations policies and procedures describe the change management process?

-What change management processes are institutionalised amongst all the projects ran by your organisation?

PART II - Change Management Scope

Q1) Identify the project team members and/or other stakeholders involved in the stage of promoting a balanced change culture and describe their roles.

Q2) Identify the project team members and/or other stakeholders involved in the change recognition stage and describe their roles.

Q3) Identify the project team members and/or other stakeholders involved in the change evaluation stage and describe their roles.

Q4) Identify the project team members and/or other stakeholders involved in the change implementation stage and describe their roles.

Q5) Identify the project team members and/or other stakeholders involved in the continuously improving from previous lessons stage and describe their roles.

Q6) Describe how the process of promoting a balanced change culture is conducted in the project and how it is integrated with other project management processes.

Q7) Describe how the process of change identification is conducted in the project and how it is integrated with other project management processes.

Q8) Describe how the process of change evaluation is conducted in the project and how it is integrated with other project management processes.

Q9) Describe how the process of change implementation is conducted in the project and how it is integrated with other project management processes.

Q10) Describe how previous lessons are used to continuously improve change management in the project and how it is integrated with other project management processes.

Q11) Describe the tools used to promote a balanced change culture in the project and comment on its effectiveness.

Q12) Describe the tools used to identify change in the project and comment on its effectiveness.

Q13) Describe the tools used to evaluate change in the project and comment on its effectiveness.

Q14) Describe the tools used to implement change in the project and comment on its effectiveness.

Q15) Describe the tools used in continuously improving the change management practices in the project and comment on its effectiveness.

APPENDIX E

This appendix shows the questionnaire survey that was used to validate the list of utilised change management processes which was previously accumulated through the literature review and the preliminary interviews.

Project Change Management in Kuwait

Dear Sir/Madam,

I am currently conducting a PhD research at Heriot-Watt University, Edinburgh, UK. The research is focused on the change management practices and procedures of contractors in Kuwait and the route to improve these practices.

The attached questionnaire has been designed to gather information about the scope of change management of contractors in Kuwait. To explore this scope, the questions of this survey will attempt to collect information about the successful practices and tools that are currently used in the contracting organization. Additionally this questionnaire has the objective of understanding the currently encountered problems in the change management process.

All the information will be dealt with in complete confidentiality and used exclusively for academic purposes. You will also be informed about the outcome of the research.

Thank you very much for your considerate cooperation.

Kind Regards,

Abdullah Mughrabi

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Project Change Management in Kuwait

PART I - BACKGROUND INFORMATION

1. What is your role in the contracting company?

- ◯ Director/Senior Manager
- ◯ Contracts Manager
- ◯ Project Manager
- ◯ Construction Manager
- ◯ Other Roles (please specify):

2. How many years of experience do you have in the construction industry?

- ◯ 0-5 Years
- ◯ 6-10 Years
- ◯ 11-15 Years
- ◯ 16-20 Years
- ◯ 21-25 Years
- ◯ More than 25 Years

3. What is the category of the contracting company you are working for?

- ◯ Category I
- ◯ Category II
- ◯ Category III
- ◯ Category IV

4. What are the types of projects is your company involved in (multiple answers may be chosen)?

- ☐ Residential Projects
- ☐ Commercial Projects
- ☐ Infrastructures, Road and Drainage Projects
- ☐ Industrial Projects
- ☐ Oil and Gas Constructions
- ☐ Other Projects (please specify)

5. How frequently do you use the following contracts?

	Always used	Very often used	Sometimes used	Rarely used	Never used
Lump sum contract	○	○	○	○	○
Remeasure contract	○	○	○	○	○
Cost plus	○	○	○	○	○

Please indicate other type(s) of contract(s) used in your organisation (if applicable).

6. How often does the used contract feature a variation clause?

- ○ Always
- ○ Very often
- ○ Sometimes
- ○ Rarely
- ○ Never

Project Change Management in Kuwait

PART II PROMOTE A BALANCED CHANGE CULTURE

7. How frequently are the following practices and tools used to promote a balanced change culture amongst the project team?

	Always used	Often used	Sometimes used	Rarely used	Never used
Assign change management roles	○	○	○	○	○
Sponsor and support the culture of change	○	○	○	○	○
Dedicate change management training, resources and funding	○	○	○	○	○
Review the feasibility of the project requirements and variation clauses prior to signing the contract	○	○	○	○	○
Circulate awareness emails	○	○	○	○	○
Share knowledge and experience through informal discussions	○	○	○	○	○
Share knowledge and experience through formal meetings	○	○	○	○	○
Share knowledge and experience through change logs of previous projects and/or shared databases	○	○	○	○	○
Encourage transparency and communication amongst team members	○	○	○	○	○
Audit the team's preparedness for change	○	○	○	○	○
Use standard forms and documentation in promoting a balanced change culture	○	○	○	○	○

Other (please specify)

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PART III IDENTIFYING CHANGE

8. How frequently are the following practices and tools used to identify change in the project?

	Always used	Often used	Sometimes used	Rarely used	Never used
Compare actual cost and quantities with the approved BOQ	◯	◯	◯	◯	◯
Compare actual quality with the contract requirements and specification	◯	◯	◯	◯	◯
Compare actual project progress with the project schedule	◯	◯	◯	◯	◯
Use Microsoft word and/or Microsoft Excel for describing the change cause(s)	◯	◯	◯	◯	◯
Communicate when a change occurs (verbally and/or writing)	◯	◯	◯	◯	◯
Use photos and/or videos for reporting the work site related changes	◯	◯	◯	◯	◯
Use value management to identify positive changes	◯	◯	◯	◯	◯
Use change prediction tools	◯	◯	◯	◯	◯
Use a database to identify potential change(s)	◯	◯	◯	◯	◯
Use root cause analysis to understand main trigger(s) of the change	◯	◯	◯	◯	◯
Use Building Information Modeling (BIM) for change identification	◯	◯	◯	◯	◯
Use standard forms and documentation in identifying change	◯	◯	◯	◯	◯

Other (please specify)

Project Change Management in Kuwait

PART IV CHANGE EVALUATION

9. How frequently are the following practices and tools used to evaluate change in the project?

	Always used	Often used	Sometimes used	Rarely used	Never used
Use trend program	○	○	○	○	○
Use web-based application for managing change orders in construction projects	○	○	○	○	○
Use system dynamics	○	○	○	○	○
Use functional analysis concept design	○	○	○	○	○
Use project change triangle tool	○	○	○	○	○
Use risk analysis to understand change implications	○	○	○	○	○
Use change prediction system using activity-based dependency structure matrix (DSM)	○	○	○	○	○
Use a change log	○	○	○	○	○
Use Building Information Modeling (BIM)	○	○	○	○	○
Use productivity oriented analysis of design revisions	○	○	○	○	○
Use records management	○	○	○	○	○
Use knowledge-based decision support system (KBDSS)	○	○	○	○	○
Use earned value methods	○	○	○	○	○
Request the expertise of the subcontractor, suppliers or the design consultants if needed	○	○	○	○	○
Use Microsoft excel to evaluate quantity and/or cost changes	○	○	○	○	○

	Always used	Often used	Sometimes used	Rarely used	Never used
Use scheduling softwares to evaluate schedule related changes	◯	◯	◯	◯	◯
Use root cause analysis	◯	◯	◯	◯	◯
Use standard forms and documentation in evaluating change	◯	◯	◯	◯	◯

Other (please specify)

8

Project Change Management in Kuwait

PART V CHANGE IMPLEMENTATION

10. How frequently are the following practices and tools used to implement and track the progress of changes in the project?

	Always used	Often used	Sometimes used	Rarely used	Never used
Monitor implemented change and report on a daily, weekly or monthly basis	◯	◯	◯	◯	◯
Use phones, messages and emails to provide updates about the change	◯	◯	◯	◯	◯
Use Microsoft excel and/or Microsoft word to monitor change	◯	◯	◯	◯	◯
Gain formal approval from the client prior to change implementation	◯	◯	◯	◯	◯
Implement minor changes that would not affect project parameters and requirements without client approval	◯	◯	◯	◯	◯
Use a change log	◯	◯	◯	◯	◯
Use a Content Management System (CMS) for communication	◯	◯	◯	◯	◯
Use Building Information Modeling (BIM)	◯	◯	◯	◯	◯
Use standard forms and documentation in implementing and monitoring change	◯	◯	◯	◯	◯

Other (please specify)

Project Change Management in Kuwait

PART VI CONTINUOUSLY IMPROVING FROM LESSONS LEARNED

11. How frequently are the following practices and tools used to continuously improve the process of managing project changes?

	Always used	Often used	Sometimes used	Rarely used	Never used
Benchmark the processes outcomes	○	○	○	○	○
Use a Content Management System (CMS) for storing and sharing lessons learned	○	○	○	○	○
Share experiences through Informal discussions	○	○	○	○	○
Share experience through the project close out meeting	○	○	○	○	○
Use, update and maintain a change log	○	○	○	○	○
Encourage professional development related to change management	○	○	○	○	○
Encourage self-driven knowledge and skills enhancement	○	○	○	○	○
Use standard forms and documentation in continuously improving from lesson learned	○	○	○	○	○

Other (please specify)

PART VII PARTICIPANTS AND STAKEHOLDERS INVOLVEMENT

12. How often are the following contracting company employees involved in the change management process?

	Always	Often	Sometimes	Rarely	Never
Project Director	◯	◯	◯	◯	◯
Project Manager	◯	◯	◯	◯	◯
Construction Manager	◯	◯	◯	◯	◯
Contract Manager	◯	◯	◯	◯	◯
Section Engineer	◯	◯	◯	◯	◯
Site Engineer	◯	◯	◯	◯	◯
Quantity Surveyor	◯	◯	◯	◯	◯
Scheduling Engineer	◯	◯	◯	◯	◯
Scheduling Manager	◯	◯	◯	◯	◯
Designer	◯	◯	◯	◯	◯
Draft Person	◯	◯	◯	◯	◯
Site Supervisor	◯	◯	◯	◯	◯

Other stakeholder(s) if applicable:

13. How often are the following stakeholders (external to the contracting company) involved in the change management process?

	Always	Often	Sometimes	Rarely	Never
Client (Public Organization)	◯	◯	◯	◯	◯
Client (Private Organization)	◯	◯	◯	◯	◯
Design Consultant	◯	◯	◯	◯	◯
Management Consultant	◯	◯	◯	◯	◯
Subcontractor	◯	◯	◯	◯	◯
Supplier	◯	◯	◯	◯	◯

Other stakeholder(s) if applicable:

PART VIII PROBLEMS IN THE CHANGE MANAGEMENT PROCESS

14. Do you agree that the following factors would negatively impact the change management process in the project?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Lack of funding	◯	◯	◯	◯	◯
Lack of training	◯	◯	◯	◯	◯
Lack of a knowledge database	◯	◯	◯	◯	◯
Lack of knowledge exchange between different project teams	◯	◯	◯	◯	◯
Lack of transparency in the organisation	◯	◯	◯	◯	◯
Lack of key stakeholders involvement, support and cooperation	◯	◯	◯	◯	◯
Lack of a prediction tool to identify change	◯	◯	◯	◯	◯
Lack of tools for evaluating the change's effect on cost	◯	◯	◯	◯	◯
Lack of tools for evaluating the change's effect on time	◯	◯	◯	◯	◯
Lack of tools for evaluating the change's effect on quality	◯	◯	◯	◯	◯
Lack of tools for evaluating the change's effect on risks	◯	◯	◯	◯	◯
Lack of an acceptance/rejection criteria in change evaluation	◯	◯	◯	◯	◯
Lack of reporting accuracy	◯	◯	◯	◯	◯
Inadequate reporting frequency	◯	◯	◯	◯	◯
Inadequate monitoring of the change status	◯	◯	◯	◯	◯

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Lack of proper documentation and record keeping	○	○	○	○	○
Lack of a standardised process	○	○	○	○	○

Indicate any other factor(s) that would negatively impact the change management process in the project.

APPENDIX F

This appendix previews the assignment of numeric values and codes in order to analyse the data collected from the questionnaire survey using the SPSS software.

Variable		Numeric Value
Role	Director/Senior Manager	1
	Contracts Manager	2
	Project Manager	3
	Construction Manager	4
	Quality Manager	5
	QA/QC Engineer	6
	Contract Administrator	7
	Scheduling Manager	8
	Scheduling Engineer	9
	Section Engineer	10
	Site Engineer	11
	Quantity Surveyor	12
	Procurement Engineer	13
	Logistics Manager	14
	Office Engineer	15
Years of experience	0-5	1
	6-10	2
	11-15	3
	16-20	4
	21-25	5
	More than 25	6
Contractor Category	I	1
	II	2
	III	3
	IV	4
Types of Projects	Residential	1
	Commercial	2
	Infrastructure, Road and Drainage	3

Variable		Numeric Value
	Industrial	4
	Oil and Gas	5

SPSS Code	**Practice/Tool**
PPC_1	Assign change management roles
PPC_2	Sponsor and support the culture of change
PPC_3	Dedicate change management training, resources and funding
PPC_4	Review the feasibility of the project requirements and variation clauses prior to signing the contract
PPC_5	Circulate awareness emails
PPC_6	Share knowledge and experience through informal discussions
PPC_7	Share knowledge and experience through formal meetings
PPC_8	Share knowledge and experience through change logs of previous projects and/or shared databases
PPC_9	Encourage transparency and communication amongst team members
PPC_10	Audit the team's preparedness for change
PPC_11	Use standard forms and documentation in promoting a balanced change culture
IC_1	Compare actual cost and quantities with the approved BOQ
IC_2	Compare actual quality with the contract requirements and specification
IC_3	Compare actual project progress with the project schedule
IC_4	Use Microsoft word and/or Microsoft Excel for describing the change cause(s)
IC_5	Communicate when a change occurs (verbally and/or writing)
IC_6	Use photos and/or videos for reporting the work site related changes
IC_7	Use value management to identify positive changes
IC_8	Use change prediction tools
IC_9	Use a database to identify potential change(s)
IC_10	Use root cause analysis to understand main trigger(s) of the change
IC_11	Use Building Information Modeling (BIM) for change identification
IC_12	Use standard forms and documentation in identifying change
EC_1	Use trend program
EC_2	Use web-based application for managing change orders in construction projects
EC_3	Use system dynamics
EC_4	Use functional analysis concept design
EC_5	Use project change triangle tool
EC_6	Use risk analysis to understand change implications
EC_7	Use change prediction system using activity-based dependency structure matrix (DSM)
EC_8	Use a change log
EC_9	Use Building Information Modeling (BIM)
EC_10	Use productivity oriented analysis of design revisions
EC_11	Use records management
EC_12	Use knowledge-based decision support system (KBDSS)
EC_13	Use earned value methods
EC_14	Request the expertise of the subcontractor, suppliers or the design consultants if needed
EC_15	Use Microsoft excel to evaluate quantity and/or cost changes
EC_16	Use scheduling software to evaluate schedule related changes
EC_17	Use root cause analysis
EC_18	Use standard forms and documentation in evaluating change
IMC_1	Monitor implemented change and report on a daily, weekly or monthly basis
IMC_2	Use phones, messages and emails to provide updates about the change
IMC_3	Use Microsoft excel and/or Microsoft word to monitor change
IMC_4	Gain formal approval from the client prior to change implementation
IMC_5	Implement minor changes that would not affect project parameters and requirements without client approval
IMC_6	Use a change log
IMC_7	Use a Content Management System (CMS) for communication
IMC_8	Use Building Information Modeling (BIM)
IMC_9	Use standard forms and documentation in implementing and monitoring change

CNT_1	Benchmark the processes outcomes
CNT_2	Use a Content Management System (CMS) for storing and sharing lessons learned
CNT_3	Share experiences through Informal discussions
CNT_4	Share experience through the project close out meeting
CNT_5	Use, update and maintain a change log
CNT_6	Encourage professional development related to change management
CNT_7	Encourage self-driven knowledge and skills enhancement
CNT_8	Use standard forms and documentation in continuously improving from lesson learned
ISTK_1	Project Director
ISTK_2	Project Manager
ISTK_3	Construction Manager
ISTK_4	Contract Manager
ISTK_5	Section Engineer
ISTK_6	Site Engineer
ISTK_7	Quantity Surveyor
ISTK_8	Scheduling Engineer
ISTK_9	Scheduling Manager
ISTK_10	Designer
ISTK_11	Draft Person
ISTK_12	Site Supervisor
ESTK_1	Client (Public Organization)
ESTK_2	Client (Private Organization)
ESTK_3	Design Consultant
ESTK_4	Management Consultant
ESTK_5	Subcontractor
ESTK_6	Supplier
PROB_1	Lack of funding
PROB_2	Lack of training
PROB_3	Lack of a knowledge database
PROB_4	Lack of knowledge exchange between different project teams
PROB_5	Lack of transparency in the organization
PROB_6	Lack of key stakeholders' involvement, support and cooperation
PROB_7	Lack of a prediction tool to identify change
PROB_8	Lack of tools for evaluating the change's effect on cost
PROB_9	Lack of tools for evaluating the change's effect on time
PROB_10	Lack of tools for evaluating the change's effect on quality
PROB_11	Lack of tools for evaluating the change's effect on risks
PROB_12	Lack of an acceptance/rejection criteria in change evaluation
PROB_13	Lack of reporting accuracy
PROB_14	Inadequate reporting frequency
PROB_15	Inadequate monitoring of the change status
PROB_16	Lack of proper documentation and record keeping
PROB_17	Lack of a standardized process

APPENDIX G

This appendix previews the principal components within the dimension reduction process of the collected data for the five different data sets.

Promoting a balanced change culture

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	6.219	56.539	56.539	6.219	56.539
2	1.171	10.649	67.188	1.171	10.649
3	.930	8.456	75.644		
4	.675	6.140	81.784		
5	.561	5.101	86.885		
6	.498	4.524	91.409		
7	.330	3.000	94.409		
8	.241	2.187	96.596		
9	.179	1.628	98.224		
10	.122	1.109	99.334		
11	.073	.666	100.000		

Total Variance Explained

Component	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings		
	Cumulative %	Total	% of Variance	Cumulative %
1	56.539	3.772	34.293	34.293
2	67.188	3.618	32.895	67.188
3				
4				
5				
6				
7				
8				
9				
10				
11				

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	4.722	39.352	39.352	4.722	39.352
2	3.352	27.930	67.283	3.352	27.930
3	1.009	8.412	75.695	1.009	8.412
4	.744	6.196	81.891		
5	.566	4.715	86.606		
6	.461	3.838	90.444		
7	.365	3.045	93.489		
8	.245	2.039	95.528		
9	.198	1.650	97.178		
10	.145	1.212	98.390		
11	.108	.901	99.291		
12	.085	.709	100.000		

Total Variance Explained

Component	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings		
	Cumulative %	Total	% of Variance	Cumulative %
1	39.352	4.707	39.229	39.229
2	67.283	2.255	18.788	58.016
3	75.695	2.121	17.679	75.695
4				
5				
6				
7				
8				
9				
10				
11				
12				

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	4.857	37.364	37.364	4.857	37.364
2	2.080	16.003	53.367	2.080	16.003
3	1.293	9.950	63.317	1.293	9.950
4	.988	7.602	70.919		
5	.836	6.433	77.352		
6	.651	5.006	82.358		
7	.524	4.031	86.388		
8	.454	3.493	89.881		
9	.391	3.009	92.891		
10	.338	2.601	95.492		
11	.259	1.993	97.485		
12	.182	1.397	98.882		
13	.145	1.118	100.000		

Total Variance Explained

Component	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings		
	Cumulative %	Total	% of Variance	Cumulative %
1	37.364	3.360	25.844	25.844
2	53.367	2.673	20.561	46.405
3	63.317	2.199	16.912	63.317
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	4.441	49.349	49.349	4.441	49.349
2	2.414	26.825	76.174	2.414	26.825
3	.716	7.956	84.130		
4	.448	4.974	89.104		
5	.372	4.136	93.241		
6	.225	2.504	95.745		
7	.182	2.022	97.767		
8	.104	1.150	98.917		
9	.097	1.083	100.000		

Total Variance Explained

Component	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings		
	Cumulative %	Total	% of Variance	Cumulative %
1	49.349	4.196	46.626	46.626
2	76.174	2.659	29.548	76.174
3				
4				
5				
6				
7				
8				
9				

Continuous improvement

Total Variance Explained

Component	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance
1	3.591	44.892	44.892	3.591	44.892
2	1.276	15.953	60.845	1.276	15.953
3	1.012	12.649	73.494		
4	.747	9.337	82.831		
5	.471	5.887	88.718		
6	.376	4.703	93.420		
7	.311	3.883	97.303		
8	.216	2.697	100.000		

Total Variance Explained

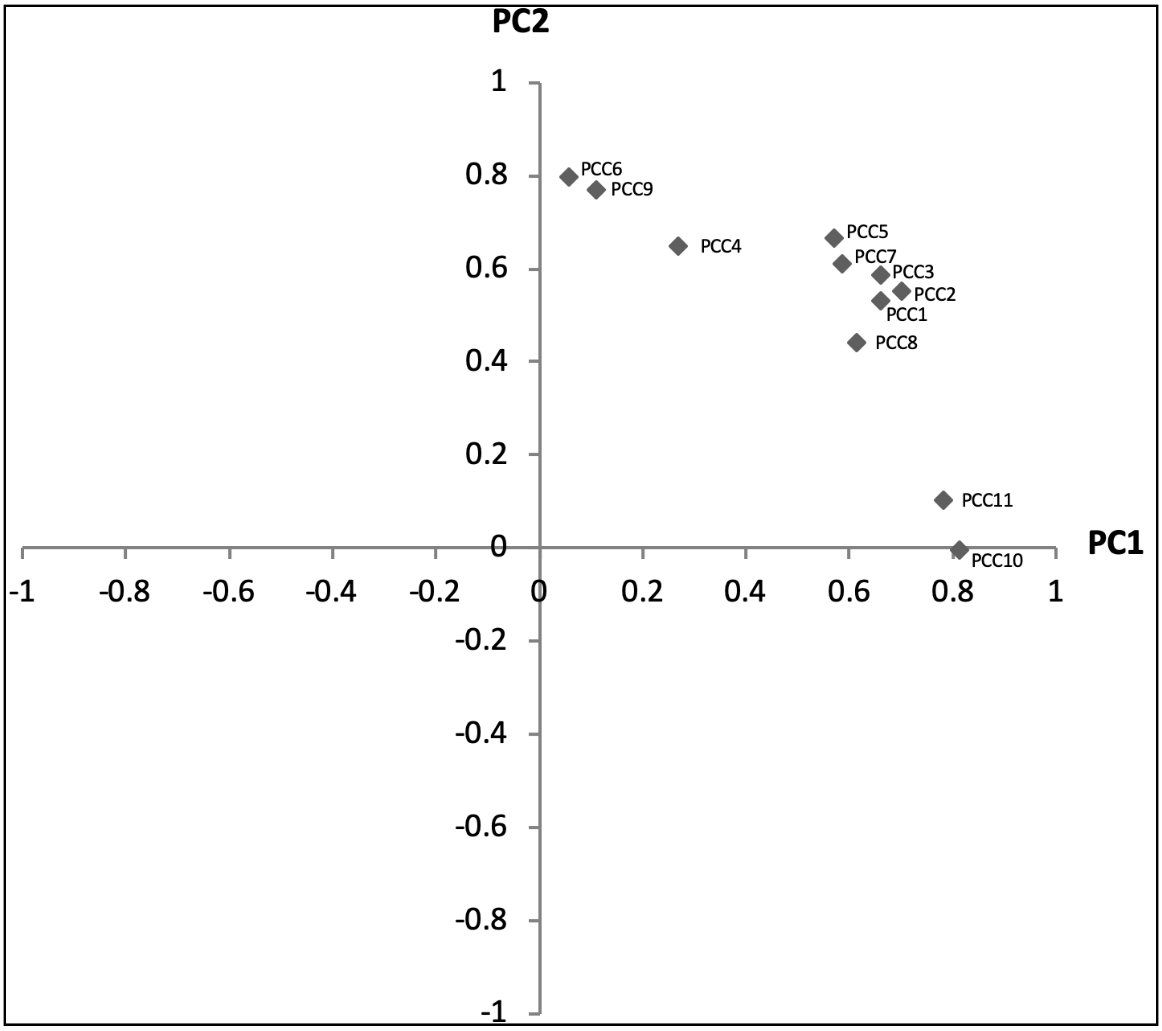
Component	Extraction Sums of Squared Loadings Cumulative %	Rotation Sums of Squared Loadings Total	Rotation Sums of Squared Loadings % of Variance	Rotation Sums of Squared Loadings Cumulative %
1	44.892	2.463	30.787	30.787
2	60.845	2.405	30.058	60.845
3				
4				
5				
6				
7				
8				

APPENDIX H

This appendix shows the loading of each element on each principal component in addition to the 2D/3D plots representing these loadings.

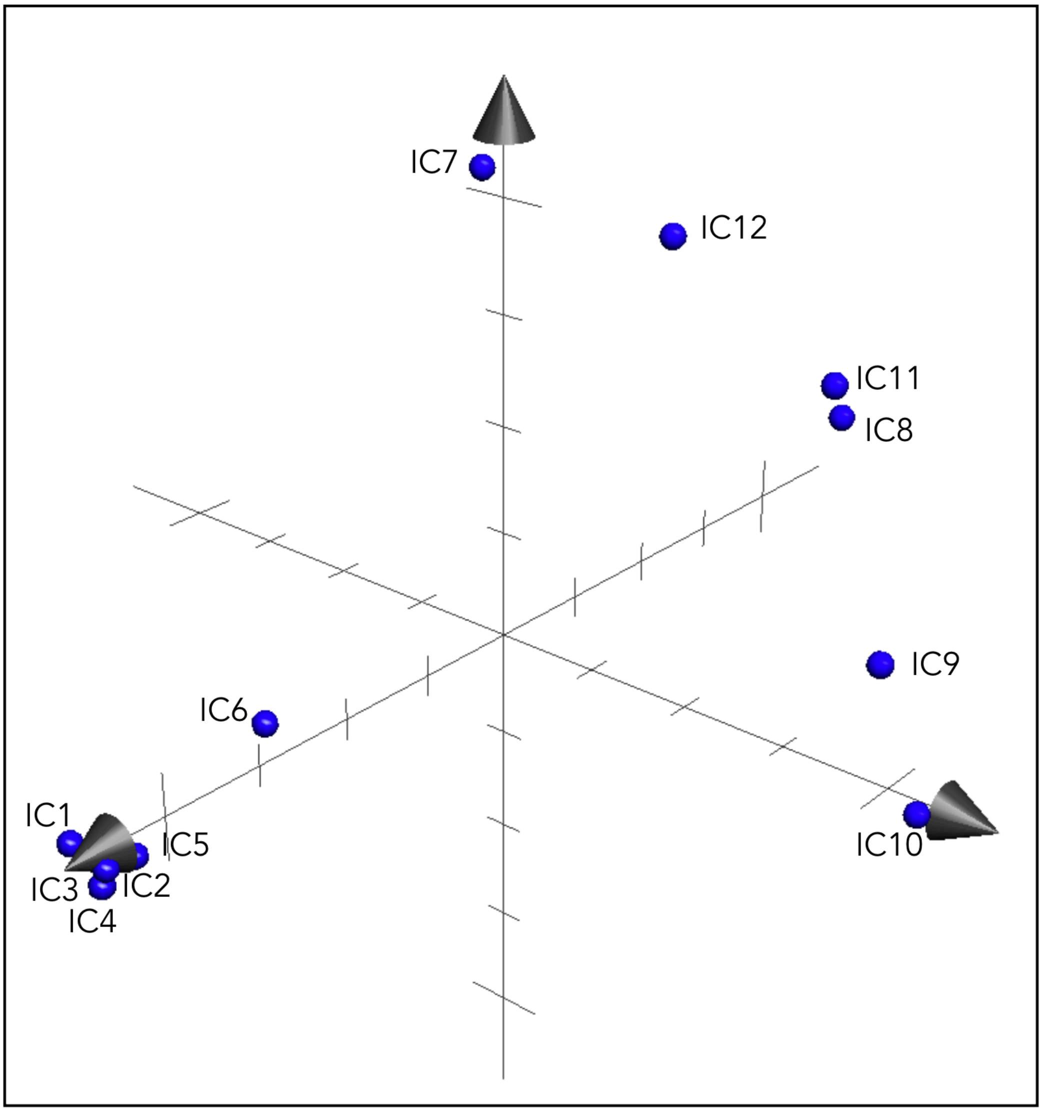
Promoting a balanced change culture

	Component	
	1	2
PCC_1	.661	.533
PCC_2	.702	.553
PCC_3	.660	.587
PCC_4	.269	.649
PCC_5	.571	.666
PCC_6	.057	.800
PCC_7	.587	.612
PCC_8	.614	.443
PCC_9	.109	.772
PCC_10	.813	-.003
PCC_11	.781	.103

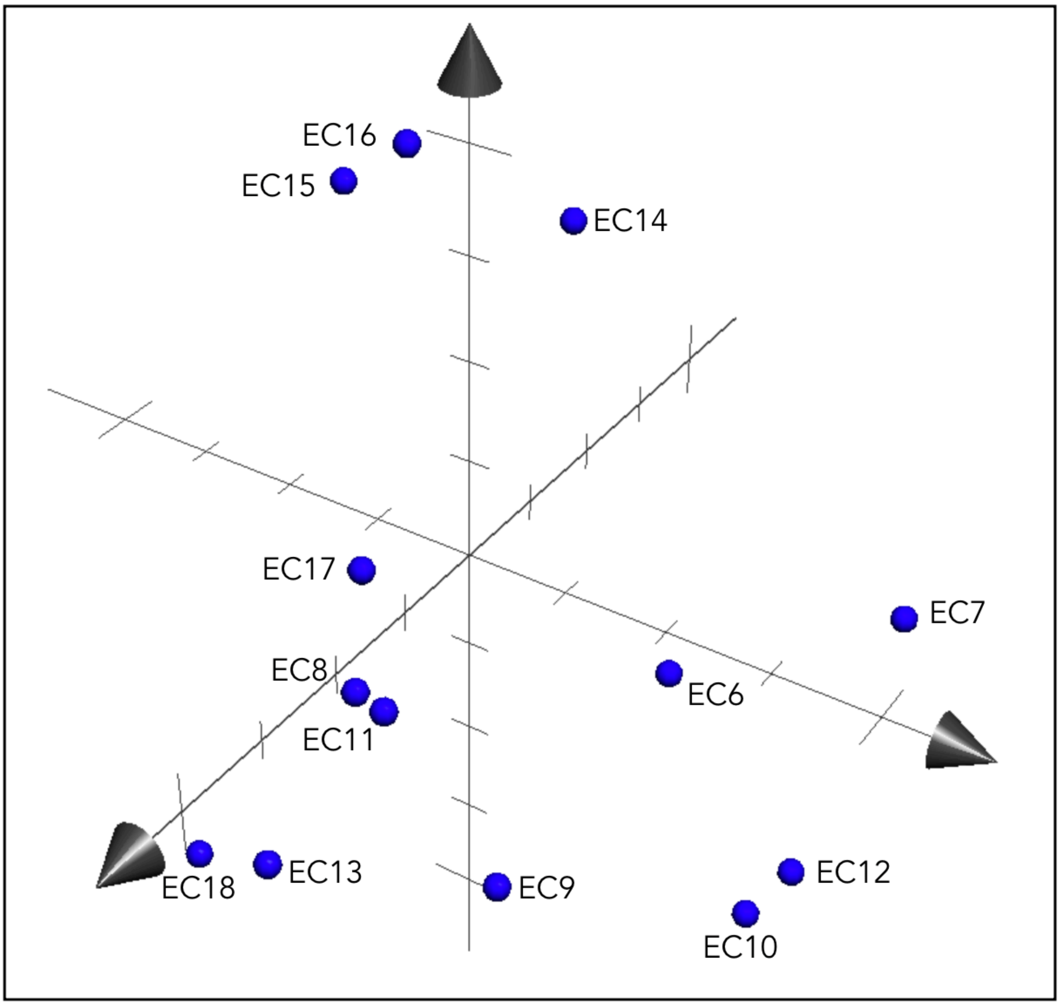


Identifying change

	Component		
	1	2	3
IC_1	.928	-.075	-.019
IC_2	.940	.023	-.016
IC_3	.926	-.010	-.070
IC_4	.921	-.014	-.073
IC_5	.873	.010	-.032
IC_6	.661	.086	.137
IC_7	.071	.016	.868
IC_8	-.198	.543	.500
IC_9	.081	.814	.260
IC_10	.067	.892	.021
IC_11	-.059	.612	.613
IC_12	-.009	.335	.802

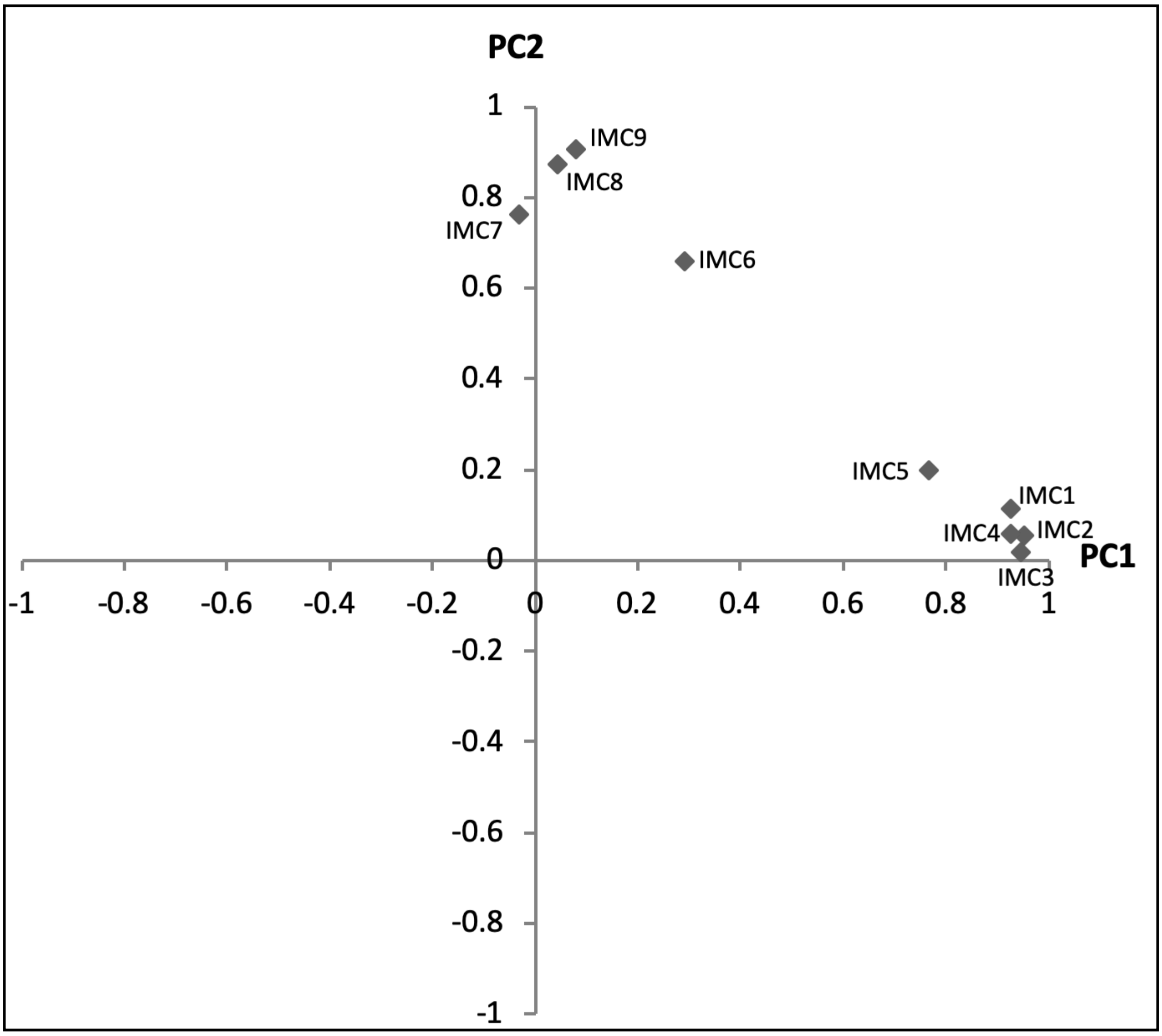


	Component		
	1	2	3
EC_6	.247	.537	.140
EC_7	-.016	.808	.194
EC_8	.669	.244	.260
EC_9	.677	.498	.010
EC_10	.386	.768	-.139
EC_11	.678	.301	.256
EC_12	.278	.790	-.126
EC_13	.862	.218	.055
EC_14	-.027	.177	.704
EC_15	.160	-.129	.766
EC_16	.177	.005	.872
EC_17	.519	.150	.350
EC_18	.798	.027	-.076



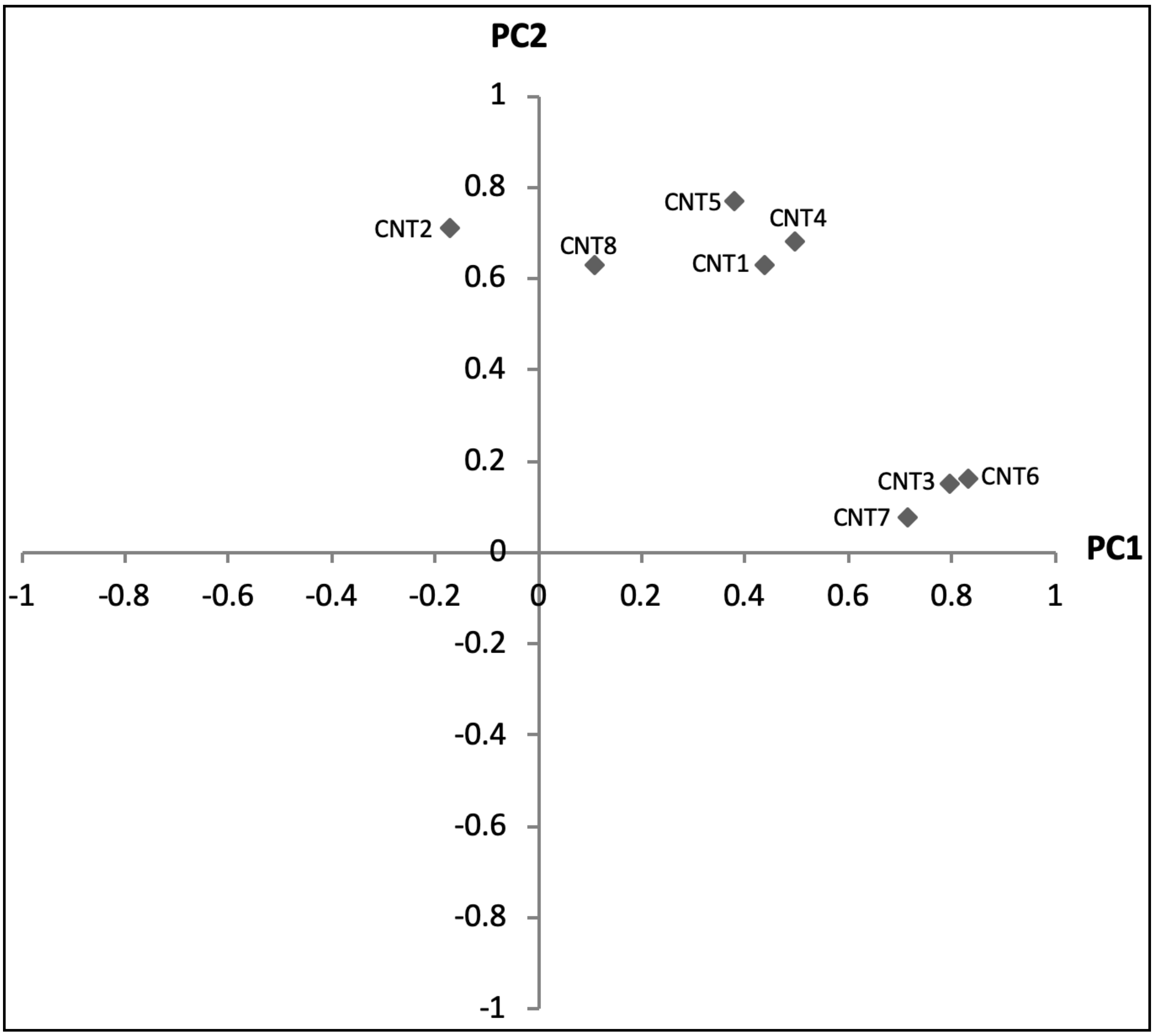
Implementing and monitoring change

	Component	
	1	2
IMC_1	.927	.115
IMC_2	.951	.055
IMC_3	.946	.019
IMC_4	.926	.059
IMC_5	.766	.197
IMC_6	.292	.661
IMC_7	-.032	.762
IMC_8	.045	.873
IMC_9	.078	.905



Continuous improvement

	Component	
	1	2
CNT_1	.436	.630
CNT_2	-.172	.711
CNT_3	.796	.149
CNT_4	.497	.681
CNT_5	.380	.768
CNT_6	.833	.161
CNT_7	.715	.077
CNT_8	.106	.628



APPENDIX I

This appendix shows the Analytic Hierarchy Process (AHP) questions that were required to assign weights to the change management practices based on significance.

PART I - INTERVIEWEE BACKGROUND

-What is your role in your organisation?

-Is your organisation related to the industry or academia?

-What is the number of years of experience do you have?

-In which domain is your work experience?

-What is the number of employees in your organisation?

-How long has your organisation been established?

PART II - PROMOTE A BALANCED CHANGE CULTURE PRACTICES/TOOLS

Compare the significance of the following practices/tools through selecting the suitable values on the shown scale. The representation of the codes mentioned beneath are shown in the attached sheet.

	Extreme	Strong		Moderate			Weak or Slight		Equal		Weak or Slight			Moderate		Strong	Extreme	
PCC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC2
PCC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC3
PCC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC8
PCC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC10
PCC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC11
PCC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC3
PCC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC8
PCC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC10
PCC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC11
PCC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC8
PCC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC10
PCC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC11
PCC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC10

PCC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC11
PCC10	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC11
PCC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC5
PCC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC6
PCC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC7
PCC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC9
PCC5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC6
PCC5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC7
PCC5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC9
PCC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC7
PCC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC9
PCC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PCC9

PART III - IDENTIFY CHANGE PRACTICES/TOOLS

Compare the significance of the following practices/tools through selecting the suitable values on the shown scale. The meaning of the codes mentioned beneath are shown in the attached sheet.

	Extreme		Strong	Moderat e			Weak or Slight		Equ al		Weak or Slight		Moderat e			Strong	Extreme	
IC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC2
IC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC3
IC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC4
IC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC5
IC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC6
IC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC3
IC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC4
IC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC5
IC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC6
IC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC4
IC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC5
IC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC6
IC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC5

IC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC6
IC5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC6
IC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC9
IC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC10
IC9	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC10
IC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC11
IC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC12
IC11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IC12

PART IV - EVALUATE CHANGE PRACTICES/TOOLS

Compare the significance of the following practices/tools through selecting the suitable values on the shown scale. The meaning of the codes mentioned beneath are shown in the attached sheet.

	Extreme		Strong		Moderate			Weak or Slight		Equal		Weak or Slight			Moderate		Strong		Extreme	
EC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC11		
EC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC13		
EC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC17		
EC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC18		
EC11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC13		
EC11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC17		
EC11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC18		
EC13	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC17		
EC13	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC18		
EC17	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC18		
EC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC7		
EC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC10		
EC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC12		

EC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC10
EC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC12
EC10	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC12
EC14	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC15
EC14	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC16
EC15	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EC16

PART V - IMPLEMENT CHANGE PRACTICES/TOOLS

Compare the significance of the following practices/tools through selecting the suitable values on the shown scale. The meaning of the codes mentioned beneath are shown in the attached sheet.

	Extreme	Strong		Moderate		Weak or Slight			Equal		Weak or Slight		Moderate		Strong		Extreme	
IMC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC2
IMC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC3
IMC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC4
IMC1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC5
IMC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC3
IMC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC4
IMC2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC5
IMC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC4
IMC3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC5
IMC4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC5
IMC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC7
IMC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC8
IMC6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC9

IMC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC8
IMC7	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC9
IMC8	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	IMC9

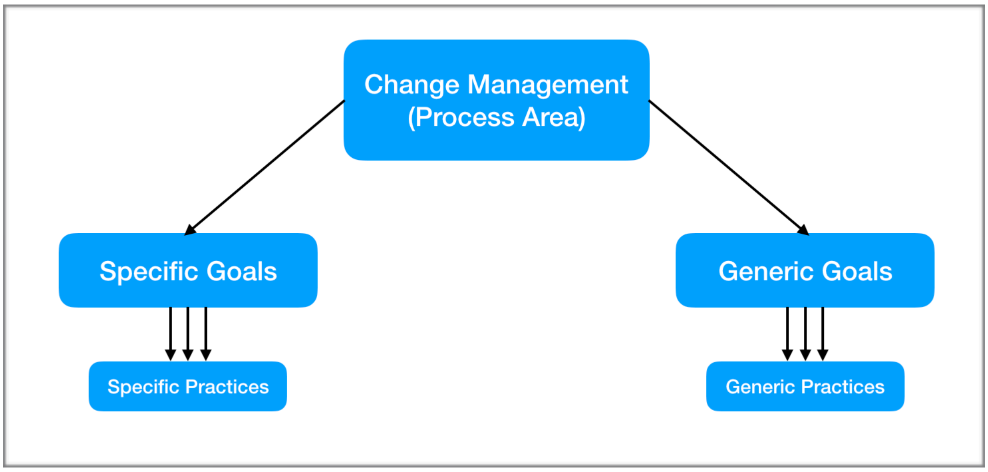
PART VI - CONTINUOUS IMPROVEMENT PRACTICES/TOOLS

Compare the significance of the following practices/tools through selecting the suitable values on the shown scale. The meaning of the codes mentioned beneath are shown in the attached sheet.

	Extreme	Strong		Moderate			Weak or Slight		Equal		Weak or Slight			Moderate		Strong	Extreme	
CNT3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT6
CNT3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT7
CNT6	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT7
CNT1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT2
CNT1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT4
CNT1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT5
CNT1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT8
CNT2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT4
CNT2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT5
CNT2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT8
CNT4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT5
CNT4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT8
CNT5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CNT8

APPENDIX J

This appendix shows hierarchy of CMCMM in addition to the generic goals, specific goals, generic practices and specific practices used in the model. The utilised capability levels are also previewed in this appendix.



Specific Goal	Specific Practice		Weight
SG1	SP1.1	Assign change management roles	17.7%
	SP1.2	Sponsor and support the culture of change	13.6%
	SP1.3	Dedicate change management training, resources and funding	27%
	SP1.4	Share knowledge and experience through change logs of previous projects and/or shared databases	13.5%
	SP1.5	Audit team's preparedness for change	23.4%
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	4.8%
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing the contract	42.2%
	SP2.2	Circulate awareness emails	18.3%
	SP2.3	Share knowledge and experience through informal discussions	8.9%
	SP2.4	Share knowledge and experience through formal meetings	21%
	SP2.5	Encourage transparency and communication amongst team members	9.6%
	SP3.1	Compare actual cost and quantities with approved BOQ	22.2%
	SP3.2	Compare actual quality with the contract requirements and specifications	15.4%

Specific Goal	Specific Practice		Weight
SG3	SP3.3	Compare actual project progress with the project schedule	23.5%
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	10.3%
	SP3.5	Communicate when a change occurs (verbally and/or writing)	21.9%
	SP3.6	Use photos and/or videos for reporting the worksite related changes	6.7%
SG4	SP4.1	Use change prediction tools	11.3%
	SP4.2	Use a database to identify potential change(s)	55.8%
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	33%
SG5	SP5.1	Use value management to identify positive change(s)	20.3%
	SP5.2	Use Building Information Modelling (BIM) for change identification	20.8%
	SP5.3	Use standard forms and documentation in identifying change	58.9%
SG6	SP6.1	Use a change log	29.8%
	SP6.2	Use records management	22.1%
	SP6.3	Use earned value methods	9.9%
	SP6.4	Use root cause analysis	23.5%
	SP6.5	Use standard forms and documentation in evaluating change	14.7%
SG7	SP7.1	Use risk analysis to understand risk implications	66.1%
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)	11.1%
	SP7.3	Use productivity oriented analysis for design revisions	9%
	SP7.4	Use knowledge-based decision support system (KBDSS)	13.8%
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	8.6%
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	52.8%
	SP8.3	Use scheduling software to evaluate schedule related changes	38.6%

Specific Goal	Specific Practice		Weight
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	19.8%
	SP9.2	Use phones, messages and emails to provide updates about the change	7.3%
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	19.4%
	SP9.4	Gain formal client approval prior to change implementation	45.9%
	SP9.5	Implement minor changes that would not affect project parameters and requirements without client approval	7.6%
SG10	SP10.1	Use a change log	36.9%
	SP10.2	Use a content management system (CMS) for communication	35.1%
	SP10.3	Use Building Information Modelling (BIM)	16.3%
	SP10.4	Use standard forms and documentation for implementing and monitoring change	11.7%
SG11	SP11.1	Share experiences through informal discussions	9%
	SP11.2	Encourage professional development related to change management	53.1%
	SP11.3	Encourage self-driven knowledge and skills enhancement	37.9%
SG12	SP12.1	Benchmark the process outcomes	20.8%
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	28.6%
	SP12.3	Share experiences through project close out meeting	9.3%
	SP12.4	Use, update and maintain a change log	26.3%
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	15%

Legend

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Generic Goal	Generic Practice
GG1 Achieve Specific Goals	GP 1.1 Perform Specific Practices
GG 2 Institutionalise a Managed Process	GP 2.1 Establish an Organisational Policy
	GP 2.2 Plan the Process
	GP 2.3 Provide Resources
	GP 2.4 Assign Responsibility
	GP 2.5 Train People
	GP 2.6 Control work products
	GP 2.7 Identify and Involve Relevant Stakeholders
	GP 2.8 Monitor and control the process
	GP 2.9 Objectively Evaluate Adherence
	GP 2.10 Review Status with Higher Level Management
GG 3 Institutionalise a Defined Process	GP 3.1 Establish a Defined Process
	GP 3.2 Collect Process Related Experiences

Capability Level	Generic Goals	Specific Goals
CL0	No GG's are completed	SG's are partially completed or absent
CL1	GG1 is completed	SG1 - SG12 are completed
CL2	GG1 & GG2 are completed	SG1 - SG12 are completed
CL3	GG1, GG2 & GG3 are completed	SG1 - SG12 are completed

APPENDIX K

This appendix shows the questionnaire used for validating CMCMM by domain experts and in the case studies.

PART I - Interviewee Background

-What is your role in your organisation?

-Is your organisation related to the industry or academia?

-What is the number of years of experience do you have?

-How long has your organisation been established?

PART II - CMCMM Improvement Criteria Evaluation

Kindly indicate how much you agree with the following statements in relevance to the attached model:

	Strongly Agree	Agree	Neither Agree Nor Disagre e	Disagre e	Strongly Disagre e
A. The improvement criteria are relevant to the domain and local industry					
B. The improvement criteria are distinct (no overlap)					
C. The improvement criteria are correctly assigned to their respective capability level					
D. The improvement criteria supports the domain advancement in the organisation					
E. The improvement criteria are clearly described with no ambiguities					

Please indicate any additional comments/suggestions you have concerning the CMCMM improvement criteria:

___

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___

PART III - CMCMM Improvement Representation Evaluation

Kindly indicate how much you agree with the following statements in relevance to the attached model:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
A. The improvement representation is clear and understandable					
B. The improvement representation is sufficient to represent the different levels of capabilities to conduct the process					
C. The improvement representation description is clear					
D. The improvement representation supports the domain improvement					

Please indicate any additional comments/suggestions you have concerning the CMCMM improvement representation:

____

____

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____

____

PART IV - CMCMM Appraisal Cycle Evaluation

Kindly indicate how much you agree with the following statements in relevance to the attached cycle:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
A. The appraisal cycle is clear and understandable					
B. The appraisal cycle is practical to be used in the industry					
C. The appraisal tool is straightforward and easy to use					
D. The appraisal tool supports the domain improvement					

Please indicate any additional comments/suggestions you have concerning the CMCMM appraisal cycle and its applicability:

Please indicate any additional comments/suggestions you have about any aspect that was not considered in the survey:

APPENDIX L

The CMCMM User Guide (Version 1.0)

1.0 Introduction

Change management is one of the fundamental pillars of a successful project within any contracting organisation. Failing to properly manage project change may cause negative effects on project parameters such as increased cost, delays, quality degradation, risk, … etc. The Change Management Capability Maturity Model (CMCMM) was developed to improve the contractor's ability to properly manage change(s) in the project. This model was developed through consulting a vast number of current practitioners in Kuwait who hold extensive experience about the industry, its parameters and constraints. CMCMM indicates through a set of criteria the capability of the contracting organisation to manage change and points out its weaknesses as a first step of improving this capability. The following sections shows the model's criteria, representation, appraisal process and explains how CMCMM can be used in the practical setting through an illustrative example.

2.0 The Model Criteria

The model criteria includes the following specific goals and practices:

Specific Goal	Specific Practice		Weight
SG1	SP1.1	Assign change management roles	18%
	SP1.2	Sponsor and support the culture of change	14%
	SP1.3	Dedicate change management training, resources and funding	27%
	SP1.4	Share knowledge and experience through change logs of previous projects and/or shared databases	14%
	SP1.5	Audit team's preparedness for change	23%
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	5%
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing the contract	42%
	SP2.2	Circulate awareness emails	18%
	SP2.3	Share knowledge and experience through informal discussions	9%
	SP2.4	Share knowledge and experience through formal meetings	21%

Specific Goal	Specific Practice		Weight
	SP2.5	Encourage transparency and communication amongst team members	10%
SG3	SP3.1	Compare actual cost and quantities with approved BOQ	22%
	SP3.2	Compare actual quality with the contract requirements and specifications	15%
	SP3.3	Compare actual project progress with the project schedule	24%
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	10%
	SP3.5	Communicate when a change occurs (verbally and/or writing)	22%
	SP3.6	Use photos and/or videos for reporting the worksite related changes	7%
SG4	SP4.1	Use change prediction tools*	11%
	SP4.2	Use a database to identify potential change(s)	56%
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	33%
SG5	SP5.1	Use value management to identify positive change(s)	20%
	SP5.2	Use Building Information Modelling (BIM) for change identification	21%
	SP5.3	Use standard forms and documentation in identifying change	59%
SG6	SP6.1	Use a change log	30%
	SP6.2	Use records management	22%
	SP6.3	Use earned value methods	10%
	SP6.4	Use root cause analysis	24%
	SP6.5	Use standard forms and documentation in evaluating change	15%
SG7	SP7.1	Use risk analysis to understand risk implications	66%
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)*	11%
	SP7.3	Use productivity oriented analysis for design revisions*	9%
	SP7.4	Use knowledge-based decision support system (KBDSS)*	14%

Specific Goal	Specific Practice		Weight
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	9%
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	53%
	SP8.3	Use scheduling software to evaluate schedule related changes	39%
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	20%
	SP9.2	Use phones, messages and emails to provide updates about the change	7%
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	19%
	SP9.4	Gain formal client approval prior to change implementation	46%
	SP9.5	Implement minor changes that would not affect project parameters and requirements without client approval	8%
SG10	SP10.1	Use a change log	37%
	SP10.2	Use a content management system (CMS) for communication*	35%
	SP10.3	Use Building Information Modelling (BIM)	16%
	SP10.4	Use standard forms and documentation for implementing and monitoring change	12%
SG11	SP11.1	Share experiences through informal discussions	9%
	SP11.2	Encourage professional development related to change management	53%
	SP11.3	Encourage self-driven knowledge and skills enhancement	38%
SG12	SP12.1	Benchmark the process outcomes	21%
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	29%
	SP12.3	Share experiences through project close out meeting	9%
	SP12.4	Use, update and maintain a change log	26%
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	15%

Legend

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* Change prediction tool: A tool that has the sole purpose of forecasting change events in the project to facilitate early arrangements to be made and minimise the potential disruptive effect of change to the biggest possible extent.

Change predicting system using activity-based dependency structure matrix (DSM): A method that is used to simulate the processes occurring after a change event based on analysing the interconnectivity of the project activities and is presented in the shape of a matrix.

Productivity oriented analysis for design revisions: a tool that can be used for tracking and controlling the design productivity disruptions within a project.

Knowledge-based decision support system (KBDSS): A framework that previews detailed variations and variation specific knowledge and analysis to aid the decision making process through facilitating an informed and effective decisions.

Content management system (CMS): An online or intranet based system that allows communication between the project team, tracking changes, making announcement and generally facilitating a robust knowledge storing and reporting database.

The model criteria also includes the following generic goals and practices:

Generic Goal	Generic Practice
GG1 Achieve Specific Goals	GP 1.1 Perform Specific Practices
GG 2 Institutionalise a Managed Process	GP 2.1 Establish an Organisational Policy
	GP 2.2 Plan the Process
	GP 2.3 Provide Resources
	GP 2.4 Assign Responsibility
	GP 2.5 Train People
	GP 2.6 Control work products
	GP 2.7 Identify and Involve Relevant Stakeholders
	GP 2.8 Monitor and control the process
	GP 2.9 Objectively Evaluate Adherence
	GP 2.10 Review Status with Higher Level Management
GG 3 Institutionalise a Defined Process	GP 3.1 Establish a Defined Process
	GP 3.2 Collect Process Related Experiences

Note:

The generic goals and practices are originated from CMMI-DEV (Version 1.3). Kindly refer to the following hyperlink for more details regarding the generic goals and practices:

https://resources.sei.cmu.edu/asset_files/TechnicalReport/2010_005_001_15287.pdf

3.0 The Model Improvement Representation

The following capability levels are used to indicate the ability to conduct change management in the model:

Capability Level**	Generic Goals	Specific Goals
CL0 (Incomplete)	No GG's are completed	SG's are partially completed or absent
CL1 (Performed)	GG1 is completed	SG1 - SG12 are completed
CL2 (Managed)	GG1 & GG2 are completed	SG1 - SG12 are completed
CL3 (Defined)	GG1, GG2 & GG3 are completed	SG1 - SG12 are completed

** The following statements clarifies how the change management capability would vary from one capability level to the other within the organisation:

CL0 (Incomplete): Change management at this level is either partially or fully not performed with one or more specific goals not satisfied due to missing specific practices.

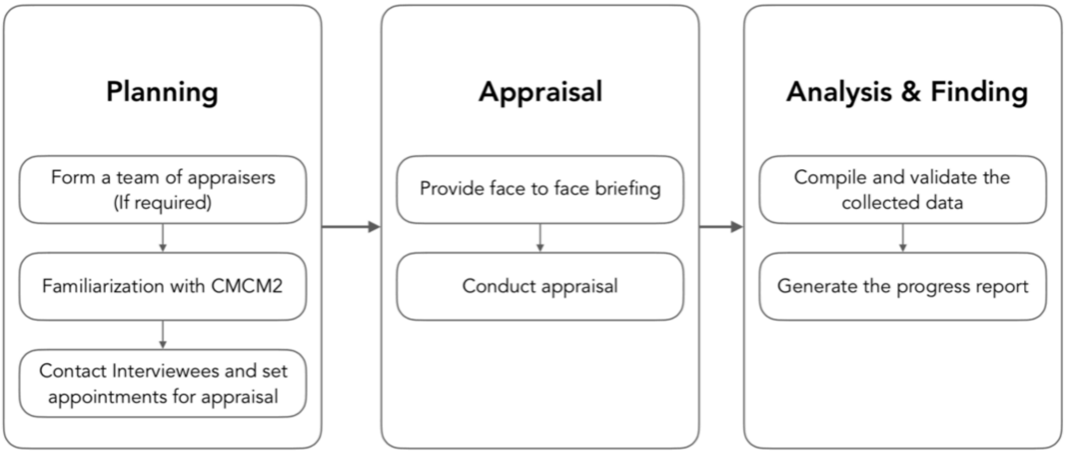
CL1 (Performed): Change management at this level is complete with all specific goals and the first generic goal satisfied. This level illustrates that a functioning change management process is established yet not maintained. In other words, the process aspects can be lost over time in case they are not standardised.

CL2 (Managed): Change management at this level is planned, monitored and evaluated, controlled, executed and reviewed according to an organisational policy. The process is also managed by competent personnel, has dedicated resources and involves all relevant stakeholders. This level requires the fulfilment of the second generic goal in addition to the first generic goal.

CL3 (Defined): Change management at this level is tailored from organisational standards to accommodate different project characteristics and parameters. The organisation's process tailoring guidelines should be continuously maintained and updated to fit the projects' needs. Information about the process conduct and deliverables are collected and analysed for continuous improvement. This level requires the fulfilment of the third generic goal in addition to the second and first generic goals.

4.0 The Appraisal Cycle

The following figure shows an overview of the appraisal cycle used in CMCMM.



<u>A) Planning:</u>

The planning phase starts with forming a team of appraisers (if possible) and familiarise this team properly with CMCMM's components and the appraisal process. This familiarisation could be through preparations sessions and/or workshops that would include understanding this user guide and ensuring the team's ability to conduct the appraisal properly and consistently. Next, it is essential to contact the party(s) that will be involved in the appraisal within the organisation. A suitable appointment should be agreed upon to avoid any rapid responses pushed by work load of the interviewee and gaining as accurate information as possible. Prior to the appointment, the appraiser should provide a briefing about CMCMM and the main objectives of the model and highlighting how beneficial it can be for improving the change management capability within the organisation. The method of appraisal is also shared in order to estimate a suitable timing for the interviewing process.

<u>B) Appraisal:</u>

This phase starts with a confirming the appraisal's objective and providing a brief introduction for change management and the utilisation of capability maturity models. The appraiser(s) also confirms the robustness of the model and that it built and customised based on the experience and knowledge or practitioners working in the Kuwaiti construction industry. Next, the appraisal checklist should be used through face-to-face structured interviews in order to understand which practices are done or not within the organisation. This tool mainly checks the fulfilment of the CMCMM specific and generic practices. The data should be collected by the appraiser(s) from multiple sources in order to avoid unreliable answers. If possible the appraiser should be external to the appraised unit to avoid any bias in appraising the capability of the organisation to manage change.

C) Analysis and Finding

The last phase of the appraisal is initiated with the compilation and validation of the collected data in order to conclude the change management capability level of the appraised organisation. The data is validated through confirming if a practice is actually conducted in the organisation according to the views of multiple interviewees. If high discrepancies are detected in responses related to the same practice, further investigation and evidence collection must be done to ensure the completion of the practice. The appraisal report is automatically generated since it is linked to the appraisal checklist tool. The report will calculate the change management capability level, indicate which practices and goals were fulfilled and which were incomplete, calculate the completion percentage of the specific goals based on the weight of the completed specific practices and show an illustrative chart of the specific goals completion profile. Any additional comments and findings mentioned in the appraisal checklist will be automatically transferred to the appraisal report. Generating an action plan based on the existing process gaps and follow through with the action plan implementation should be done by the appraised organisation. The frequency of the appraisal is also determined by the organisation's dedication to improving its capability to successfully manage change.

5.0 The Appraisal Checklist

Specific Goal	Specific Practice			Comments
SG1	SP1.1	Assign change management roles		
	SP1.2	Sponsor and support the culture of change		
	SP1.3	Dedicate change management training, resources and funding		
	SP1.4	Share knowledge and experience through change logs of previous projects and/or		
	SP1.5	Audit team's preparedness for change		
	SP1.6	Use standard forms and documentation in promoting a balanced change culture		
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing		
	SP2.2	Circulate awareness emails		
	SP2.3	Share knowledge and experience through informal discussions		
	SP2.4	Share knowledge and experience through formal meetings		
	SP2.5	Encourage transparency and communication amongst team members		
SG3	SP3.1	Compare actual cost and quantities with approved BOQ		
	SP3.2	Compare actual quality with the contract requirements and specifications		
	SP3.3	Compare actual project progress with the project schedule		
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)		
	SP3.5	Communicate when a change occurs (verbally and/or writing)		
	SP3.6	Use photos and/or videos for reporting the worksite related changes		
SG4	SP4.1	Use change prediction tools		
	SP4.2	Use a database to identify potential change(s)		
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change		
SG5	SP5.1	Use value management to identify positive change(s)		
	SP5.2	Use Building Information Modeling (BIM) for change identification		
	SP5.3	Use standard forms and documentation in identifying change		
SG6	SP6.1	Use a change log		
	SP6.2	Use records management		
	SP6.3	Use earned value methods		
	SP6.4	Use root cause analysis		
	SP6.5	Use standard forms and documentation in evaluating change		
SG7	SP7.1	Use risk analysis to understand risk implications		
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)		
	SP7.3	Use productivity oriented analysis for design revisions		
	SP7.4	Use knowledge-based decision support system (KBDSS)		
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed		
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes		
	SP8.3	Use scheduling software to evaluate schedule related changes		
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis		
	SP9.2	Use phones, messages and emails to provide updates about the change		
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change		
	SP9.4	Gain formal client approval prior to change implementation		
	SP9.5	Implement minor changes that would not affect project parameters and requirements		
SG10	SP10.1	Use a change log		
	SP10.2	Use a content management system (CMS) for communication		
	SP10.3	Use Building Information Modeling (BIM)		
	SP10.4	Use standard forms and documentation for implementing and monitoring change		
SG11	SP11.1	Share experiences through informal discussions		
	SP11.2	Encourage professional development related to change management		
	SP11.3	Encourage self-driven knowledge and skills enhancement		
SG12	SP12.1	Benchmark the process outcomes		
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned		
	SP12.3	Share experiences through project close out meeting		
	SP12.4	Use, update and maintain a change log		
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned		

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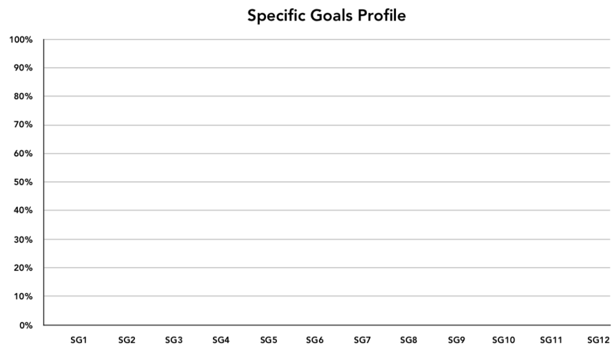
Generic Goal	Generic Practice		Comments
GG1 Achieve Specific Goals	GP 1.1 Perform Specific Practices		
GG 2 Institutionalize a Managed Process	GP 2.1 Establish an Organizational Policy		
	GP 2.2 Plan the Process		
	GP 2.3 Provide Resources		
	GP 2.4 Assign Responsibility		
	GP 2.5 Train People		
	GP 2.6 Control work products		
	GP 2.7 Identify and Involve Relevant Stakeholders		
	GP 2.8 Monitor and control the process		
	GP 2.9 Objectively Evaluate Adherence		
	GP 2.10 Review Status with Higher Level Management		
GG 3 Institutionalize a Defined Process	GP 3.1 Establish a Defined Process		
	GP 3.2 Collect Process Related Experiences		

Appraiser(s) Initials:

Appraisal Date:

6.0 The Appraisal Report

Capability Level	0



		Progress
Specific Goals	SG1	0%
	SG2	0%
	SG3	0%
	SG4	0%
	SG5	0%
	SG6	0%
	SG7	0%
	SG8	0%
	SG9	0%
	SG10	0%
	SG11	0%
	SG12	0%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived

Specific / Generic Practice		Comments
SP1.1	Assign change management roles	
SP1.2	Sponsor and support the culture of change	
SP1.3	Dedicate change management training, resources and funding	
SP1.4	Share knowledge and experience through change logs of previous projects and/or shared databases	
SP1.5	Audit team's preparedness for change	
SP1.6	Use standard forms and documentation in promoting a balanced change culture	
SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing the contract	
SP2.2	Circulate awareness emails	
SP2.3	Share knowledge and experience through informal discussions	
SP2.4	Share knowledge and experience through formal meetings	
SP2.5	Encourage transparency and communication amongst team members	
SP3.1	Compare actual cost and quantities with approved BOQ	
SP3.2	Compare actual quality with the contract requirements and specifications	
SP3.3	Compare actual project progress with the project schedule	
SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	
SP3.5	Communicate when a change occurs (verbally and/or writing)	
SP3.6	Use photos and/or videos for reporting the worksite related changes	
SP4.1	Use change prediction tools	
SP4.2	Use a database to identify potential change(s)	
SP4.3	Use root cause analysis to understand the main trigger(s) of the change	
SP5.1	Use value management to identify positive change(s)	
SP5.2	Use Building Information Modeling (BIM) for change identification	
SP5.3	Use standard forms and documentation in identifying change	
SP6.1	Use a change log	
SP6.2	Use records management	
SP6.3	Use earned value methods	
SP6.4	Use root cause analysis	
SP6.5	Use standard forms and documentation in evaluating change	
SP7.1	Use risk analysis to understand risk implications	
SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)	
SP7.3	Use productivity oriented analysis for design revisions	
SP7.4	Use knowledge-based decision support system (KBDSS)	
SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	
SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	
SP8.3	Use scheduling software to evaluate schedule related changes	
SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	
SP9.2	Use phones, messages and emails to provide updates about the change	
SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	
SP9.4	Gain formal client approval prior to change implementation	
SP9.5	Implement minor changes that would not affect project parameters and requirements without client approval	
SP10.1	Use a change log	
SP10.2	Use a content management system (CMS) for communication	
SP10.3	Use Building Information Modeling (BIM)	
SP10.4	Use standard forms and documentation for implementing and monitoring change	
SP11.1	Share experiences through informal discussions	
SP11.2	Encourage professional development related to change management	
SP11.3	Encourage self-driven knowledge and skills enhancement	
SP12.1	Benchmark the process outcomes	
SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	
SP12.3	Share experiences through project close out meeting	
SP12.4	Use, update and maintain a change log	
SP12.5	Use standard forms and documentation in continuously improving from lessons learned	
GP 1.1	Perform Specific Practices	
GP 2.1	Establish an Organizational Policy	
GP 2.2	Plan the Process	
GP 2.3	Provide Resources	
GP 2.4	Assign Responsibility	
GP 2.5	Train People	
GP 2.6	Control work products	
GP 2.7	Identify and Involve Relevant Stakeholders	
GP 2.8	Monitor and control the process	
GP 2.9	Objectively Evaluate Adherence	
GP 2.10	Review Status with Higher Level Management	
GP 3.1	Establish a Defined Process	
GP 3.2	Collect Process Related Experiences	

7.0 CMCMM Example

The following scenario is shown for the purpose of clarifying how CMCMM operates only and is not based on a real organisation.

Scenario (Company X):

Company X is based in Kuwait and is continuously suffering from cost overruns in some of its projects due to improperly managed project changes. The company has procured an expert for consultation on the current situation and possible solutions of the faced challenge. The expert gained approval from the relevant stakeholders to use the Change Management Capability Maturity Model (CMCMM) in order to find the weaknesses in the process and advise on potential solutions of the current situation.

A team of appraisers was formed and properly brief to the usage of CMCMM. Appointments were scheduled and the appraisal was then conducted with multiple project managers working Company X and the data was collected from three project managers. When the data was collected, few discrepancies in the responses were detected. To clarify the situation, the appraisal team requested evidence of conducting the specific practices SP3.1, SP4.2 and SP10.4. No substantial evidence of the SP's fulfilment was provided therefore these practices were considered missing from change management process used the contracting company. The report was then automatically generated (since it is connected with the appraisal checklist) showing the necessary information that clarifies the current state of change management capability. Clearly, there are missing specific practices in the organisation which resulted in a Capability Level 0 thus indicating an incomplete process. Since the specific goals were not completely achieved, there was no use to continue the appraisal and check the generic goals as this will not result in any increase in the concluded capability level without completing the specific goals first. Finally, the report was passed by to the point of contact in the company for creating an action plan and following through with implementing improvements.

Specific Goal	Specific Practice			Comments
SG1	SP1.1	Assign change management roles	✓	
	SP1.2	Sponsor and support the culture of change	☐	
	SP1.3	Dedicate change management training, resources and funding	✓	
	SP1.4	Share knowledge and experience through change logs of previous projects and/or	✓	
	SP1.5	Audit team's preparedness for change	✓	
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	☐	
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing	✓	
	SP2.2	Circulate awareness emails	☐	
	SP2.3	Share knowledge and experience through informal discussions	✓	
	SP2.4	Share knowledge and experience through formal meetings	☐	
	SP2.5	Encourage transparency and communication amongst team members	☐	
SG3	SP3.1	Compare actual cost and quantities with approved BOQ	☐	
	SP3.2	Compare actual quality with the contract requirements and specifications	✓	
	SP3.3	Compare actual project progress with the project schedule	☐	
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	✓	
	SP3.5	Communicate when a change occurs (verbally and/or writing)	☐	
	SP3.6	Use photos and/or videos for reporting the worksite related changes	✓	
SG4	SP4.1	Use change prediction tools	☐	
	SP4.2	Use a database to identify potential change(s)	☐	
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	✓	
SG5	SP5.1	Use value management to identify positive change(s)	✓	
	SP5.2	Use Building Information Modeling (BIM) for change identification	☐	
	SP5.3	Use standard forms and documentation in identifying change	☐	
SG6	SP6.1	Use a change log	✓	
	SP6.2	Use records management	☐	
	SP6.3	Use earned value methods	✓	
	SP6.4	Use root cause analysis	✓	
	SP6.5	Use standard forms and documentation in evaluating change	☐	
SG7	SP7.1	Use risk analysis to understand risk implications	✓	
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)	☐	
	SP7.3	Use productivity oriented analysis for design revisions	☐	
	SP7.4	Use knowledge-based decision support system (KBDSS)	☐	
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	✓	
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	☐	
	SP8.3	Use scheduling software to evaluate schedule related changes	✓	
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	☐	
	SP9.2	Use phones, messages and emails to provide updates about the change	✓	
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	✓	
	SP9.4	Gain formal client approval prior to change implementation	☐	
	SP9.5	Implement minor changes that would not affect project parameters and requirements	☐	
SG10	SP10.1	Use a change log	✓	
	SP10.2	Use a content management system (CMS) for communication	✓	
	SP10.3	Use Building Information Modeling (BIM)	☐	
	SP10.4	Use standard forms and documentation for implementing and monitoring change	☐	
SG11	SP11.1	Share experiences through informal discussions	✓	
	SP11.2	Encourage professional development related to change management	☐	
	SP11.3	Encourage self-driven knowledge and skills enhancement	☐	
SG12	SP12.1	Benchmark the process outcomes	✓	
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	✓	
	SP12.3	Share experiences through project close out meeting	✓	
	SP12.4	Use, update and maintain a change log	☐	
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	✓	

Promoting a balanced change culture

Identifying Change

Evaluating Change

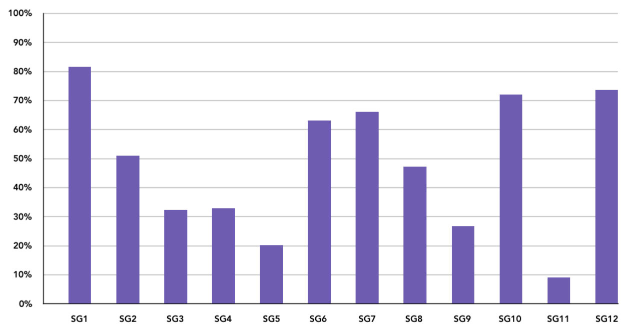
Implementing and Monitoring Change

Continuos Improvement

Capability Level	0

		Progress
Specific Goals	SG1	82%
	SG2	51%
	SG3	32%
	SG4	33%
	SG5	20%
	SG6	63%
	SG7	66%
	SG8	47%
	SG9	27%
	SG10	72%
	SG11	9%
	SG12	74%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived

Specific Goals Profile



Appraisers Comments

Evidence of the availability of SP3.1, SP4.2 and SP10.4 was requested and none was available. Therefore these three practices will be considered absent in the appraisal checklist and subsequently the appraisal report.

Specific Goal	Specific Practice		
SG1	SP1.1	Assign change management roles	✓
	SP1.2	Sponsor and support the culture of change	☐
	SP1.3	Dedicate change management training, resources and funding	✓
	SP1.4	Share knowledge and experience through change logs of previous projects and/or	✓
	SP1.5	Audit team's preparedness for change	✓
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	☐
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing	✓
	SP2.2	Circulate awareness emails	☐
	SP2.3	Share knowledge and experience through informal discussions	✓
	SP2.4	Share knowledge and experience through formal meetings	☐
	SP2.5	Encourage transparency and communication amongst team members	☐
SG3	SP3.1	Compare actual cost and quantities with approved BOQ	☐
	SP3.2	Compare actual quality with the contract requirements and specifications	✓
	SP3.3	Compare actual project progress with the project schedule	☐
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	✓
	SP3.5	Communicate when a change occurs (verbally and/or writing)	☐
	SP3.6	Use photos and/or videos for reporting the worksite related changes	✓
SG4	SP4.1	Use change prediction tools	☐
	SP4.2	Use a database to identify potential change(s)	☐
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	✓
SG5	SP5.1	Use value management to identify positive change(s)	✓
	SP5.2	Use Building Information Modeling (BIM) for change identification	☐
	SP5.3	Use standard forms and documentation in identifying change	☐
SG6	SP6.1	Use a change log	✓
	SP6.2	Use records management	☐
	SP6.3	Use earned value methods	✓
	SP6.4	Use root cause analysis	✓
	SP6.5	Use standard forms and documentation in evaluating change	☐
SG7	SP7.1	Use risk analysis to understand risk implications	✓
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)	☐
	SP7.3	Use productivity oriented analysis for design revisions	☐
	SP7.4	Use knowledge-based decision support system (KBDSS)	☐
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	✓
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	☐
	SP8.3	Use scheduling software to evaluate schedule related changes	✓
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	☐
	SP9.2	Use phones, messages and emails to provide updates about the change	✓
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	✓
	SP9.4	Gain formal client approval prior to change implementation	☐
	SP9.5	Implement minor changes that would not affect project parameters and requirements	☐
SG10	SP10.1	Use a change log	✓
	SP10.2	Use a content management system (CMS) for communication	✓
	SP10.3	Use Building Information Modeling (BIM)	☐
	SP10.4	Use standard forms and documentation for implementing and monitoring change	☐
SG11	SP11.1	Share experiences through informal discussions	✓
	SP11.2	Encourage professional development related to change management	☐
	SP11.3	Encourage self-driven knowledge and skills enhancement	☐
SG12	SP12.1	Benchmark the process outcomes	✓
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	✓
	SP12.3	Share experiences through project close out meeting	✓
	SP12.4	Use, update and maintain a change log	☐
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	✓

APPENDIX M

PART I - Interviewee Background

-What is your role in your organisation?

-What is your level of education?

-What is the number of years of experience you have in this company?

-What is the number of years of experience you have in general?

PART II - CMCMM Improvement Criteria Evaluation

Kindly indicate how much you agree with the following statements in relevance to the attached model:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
A. The improvement criteria are relevant to the domain and local industry					
B. The improvement criteria are distinct (no overlap)					
C. The improvement criteria are correctly assigned to their respective capability level					
D. The improvement criteria supports the domain advancement in the organisation					
E. The improvement criteria are clearly described with no ambiguities					

Please indicate any additional comments/suggestions you have concerning the CMCMM improvement criteria:

PART III - CMCMM Improvement Representation Evaluation

Kindly indicate how much you agree with the following statements in relevance to the attached model:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
A. The improvement representation is clear and understandable					
B. The improvement representation is sufficient to represent the different levels of capabilities to conduct the process					
C. The improvement representation description is clear					
D. The improvement representation supports the domain improvement					

Please indicate any additional comments/suggestions you have concerning the CMCMM improvement representation:

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PART IV - CMCMM Appraisal Cycle Evaluation

Kindly indicate how much you agree with the following statements in relevance to the attached cycle:

	Strongly Agree	Agree	Neither Agree Nor Disagre e	Disagre e	Strongly Disagre e
A. The appraisal cycle is clear and understandable					
B. The appraisal cycle is practical to be used in the industry					
C. The appraisal tool is straightforward and easy to use					
D. The appraisal tool supports the domain improvement					
E. The charts and visual aids used in the appraisal report are clear and effective to reflect improvement.					

Please indicate any additional comments/suggestions you have concerning the CMCMM appraisal cycle and its applicability:

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PART V - CMCMM User Guide

	Strongly Agree	Agree	Neither Agree Nor Disagre e	Disagre e	Strongly Disagre e
A. The guide provides clear a sufficient level of detail regarding the model background information.					
B. The example mentioned helps in understanding the usage of the model.					
C. The user guide is helpful for a user with prior knowledge of Capability Maturity Models.					
D. The user guide is helpful for a user with no prior knowledge of Capability Maturity Models.					

Please indicate any additional comments/suggestions you have concerning the CMCMM user guide:

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Please indicate any additional comments/suggestions you have about any aspect that was not considered in the survey:

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APPENDIX N

The CMCMM User Guide (Version 2.0)

1.0 Introduction

Change management is one of the fundamental pillars of a successful project within any contracting organisation. Failing to properly manage project change may cause negative effects on project parameters such as increased cost, delays, quality degradation, risk, … etc. The Change Management Capability Maturity Model (CMCMM) was developed to improve the contractor's ability to properly manage change(s) in the project. This model was developed through consulting a vast number of current practitioners in Kuwait who hold extensive experience about the industry, its parameters and constraints. CMCMM indicates through a set of criteria the capability of the contracting organisation to manage change and points out its weaknesses as a first step of improving this capability.

The target audience for this user guide are any stakeholders involved in the appraisal process. This includes the appraiser and the party being appraised. It is also beneficial for any stakeholder aiming to gain a better insight towards the shaper of a complete change management process that would yield a positive output in the project.

The following sections shows the model's criteria, representation, appraisal process and explains how CMCMM can be used in the practical setting through an illustrative example.

2.0 Background

The Capability Maturity Model (CMM) concept was first developed by the U.S. Department of Defense, Software Engineering Institute (SEI) in Carnegie Mellon University as a method to objectively evaluate the ability of government contractors to perform military software projects in the 1980s. CMM is a framework that facilitates a path of improvements which are tailored to the organisation's that aim and objectives in order to enhance their capabilities of to properly conduct the requires tasks and activities.

Even though CMM initially targeted the software industry, it has been fruitfully used in different process areas. This evolution was triggered on the basis that CMM proved its robustness and applicability beyond the software industry. This concept has evolved into a framework of process improvement models known as Capability Maturity Model Integration (CMMI). This framework currently includes CMMI development (CMMI-

DEV), acquisition (CMMI-ACQ) and services (CMMI-SVC). These different frameworks cover different process areas based on the strategy and requirements of the organisations. The CMMI was used as a basis to develop the change management capability maturity model (CMCMM).

CMM's are simply created from two components which are improvement criteria and improvement representation. Improvement criteria is the prerequisites required to achieve a specific level of growth while improvement representation refers to the levels used to indicate maturity in the models. The improvement criteria is represented by the following components:

<u>Generic Goals (GG)</u>

A model component that describes the needed characteristics to institutionalise the processes that implement a process area.

<u>Generic Practices (GP)</u>

The practices needed to achieve the associated generic goal.

<u>Specific Goals (SG)</u>

A model component that describes the unique characteristics needed to satisfy the process area.

<u>Specific Practices (SP)</u>

The practices needed to achieve the associated specific goals.

There are two improvement representations were mentioned in the Capability Maturity Model Integration (CMMI) which are correlated to different progressing levels (maturity & capability levels) that allows the organisation to pursue different objectives.

- The first representation in the CMMI is the staged approach which necessitates the availability of predetermined process areas to achieve a certain maturity level in the organisation. Maturing in this representation requires achieving improvements across multiple process areas. This representation would also indicate which process areas are necessitated to achieve the next level of maturity in the organisation. Gaining improved organisational maturity secures the stability of the established processes and improved predictability for the organisational process outputs.

- The second representation is the continuous approach which groups the process areas together to form modules which are previewed in CMMI as the process management, project management, engineering and support group. The module is observed closely and each process area is evaluated and assigned an individual score or maturity to represent the team's ability in conducting that specific process. This representation would provide the organisation with a more detailed look into its capability within a specific process which is the first step into improving a certain process areas without being overwhelmed with improving the entire organisational processes. In other words, the continuous approach targets incremental and more manageable improvements for specific areas of concern. This representation was found more suitable for the purpose of CMCMM thus was used in the model.

The CMCMM model uses the following change management stages as a basis for its criteria:

Promoting a balanced change culture

This stage is concerned with spreading awareness of the true meaning of beneficial and detrimental changes. Beneficial changes which could have a positive influence on the project parameter and creates a continuous improvement environment, should be encouraged while the detrimental changes which would negatively impact the project should be prevented.

Identifying change

This stage is where the project team would identify any alterations to the project aspects that were previously agreed upon by the project stakeholders in the contract.

Evaluating change

This stage is where the variation is evaluated for its effect on the project. It is one of the most critical phases as a wrong decision may have a ripple effect thus the project team should follow a systematic way in observing the potential consequences of the change before taking action.

Implementing & monitoring change

The stage when relevant stakeholders introduce the changes and monitoring any updates related to these changes in the project. The project team should commit to implementing major changes only upon the formal client approval to avoid any consequent conundrums such as refusal of payment.

Continuous Improvement

Continuous improvement is the phase of the change management where the knowledge and experiences of managing changes are reviewed and shared by the project team.

3.0 The Model Improvement Criteria

The model criteria includes the following specific goals and practices:

Specific Goal	Specific Practice		Weight
SG1	SP1.1	Assign change management roles	18%
	SP1.2	Sponsor and support the culture of change	14%
	SP1.3	Dedicate change management training, resources and funding	27%
	SP1.4	Share knowledge and experience through change logs of previous projects and/or shared databases	14%
	SP1.5	Audit team's preparedness for change	23%
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	5%
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing the contract	42%
	SP2.2	Circulate awareness emails	18%
	SP2.3	Share knowledge and experience through informal discussions	9%
	SP2.4	Share knowledge and experience through formal meetings	21%
	SP2.5	Encourage transparency and communication amongst team members	10%
SG3	SP3.1	Compare actual cost and quantities with approved BOQ	22%
	SP3.2	Compare actual quality with the contract requirements and specifications	15%
	SP3.3	Compare actual project progress with the project schedule	24%
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	10%
	SP3.5	Communicate when a change occurs (verbally and/or writing)	22%
	SP3.6	Use photos and/or videos for reporting the worksite related changes	7%
SG4	SP4.1	Use change prediction tools*	11%
	SP4.2	Use a database to identify potential change(s)	56%
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	33%
	SP5.1	Use value management to identify positive change(s)	20%

Specific Goal	Specific Practice		Weight
SG5	SP5.2	Use Building Information Modelling (BIM) for change identification	21%
	SP5.3	Use standard forms and documentation in identifying change	59%
SG6	SP6.1	Use a change log	30%
	SP6.2	Use records management	22%
	SP6.3	Use earned value methods	10%
	SP6.4	Use root cause analysis	24%
	SP6.5	Use standard forms and documentation in evaluating change	15%
SG7	SP7.1	Use risk analysis to understand risk implications	66%
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)*	11%
	SP7.3	Use productivity oriented analysis for design revisions*	9%
	SP7.4	Use knowledge-based decision support system (KBDSS)*	14%
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	9%
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	53%
	SP8.3	Use scheduling software to evaluate schedule related changes	39%
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	20%
	SP9.2	Use phones, messages and emails to provide updates about the change	7%
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	19%
	SP9.4	Gain formal client approval prior to change implementation	46%
	SP9.5	Implement minor changes that would not affect project parameters and requirements without client approval	8%
SG10	SP10.1	Use a change log	37%
	SP10.2	Use a content management system (CMS) for communication*	35%
	SP10.3	Use Building Information Modelling (BIM)	16%

Specific Goal		Specific Practice	Weight
	SP10.4	Use standard forms and documentation for implementing and monitoring change	12%
SG11	SP11.1	Share experiences through informal discussions	9%
	SP11.2	Encourage professional development related to change management	53%
	SP11.3	Encourage self-driven knowledge and skills enhancement	38%
SG12	SP12.1	Benchmark the process outcomes	21%
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	29%
	SP12.3	Share experiences through project close out meeting	9%
	SP12.4	Use, update and maintain a change log	26%
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	15%

Legend

Promoting a balanced change culture

Identifying Change

Evaluating Change

Implementing and Monitoring Change

Continuos Improvement

* Change prediction tool: A tool that has the sole purpose of forecasting change events in the project to facilitate early arrangements to be made and minimise the potential disruptive effect of change to the biggest possible extent.

Change predicting system using activity-based dependency structure matrix (DSM): A method that is used to simulate the processes occurring after a change event based on analysing the interconnectivity of the project activities and is presented in the shape of a matrix.

Productivity oriented analysis for design revisions: a tool that can be used for tracking and controlling the design productivity disruptions within a project.

Knowledge-based decision support system (KBDSS): A framework that previews detailed variations and variation specific knowledge and analysis to aid the decision making process through facilitating an informed and effective decisions.

Content management system (CMS): An online or intranet based system that allows communication between the project team, tracking changes, making announcement and generally facilitating a robust knowledge storing and reporting database.

The model criteria also includes the following generic goals and practices:

Generic Goal	Generic Practice
GG1 Achieve Specific Goals	GP 1.1 Perform Specific Practices
GG 2 Institutionalise a Managed Process	GP 2.1 Establish an Organisational Policy
	GP 2.2 Plan the Process
	GP 2.3 Provide Resources
	GP 2.4 Assign Responsibility
	GP 2.5 Train People
	GP 2.6 Control work products
	GP 2.7 Identify and Involve Relevant Stakeholders
	GP 2.8 Monitor and control the process
	GP 2.9 Objectively Evaluate Adherence
	GP 2.10 Review Status with Higher Level Management
GG 3 Institutionalise a Defined Process	GP 3.1 Establish a Defined Process
	GP 3.2 Collect Process Related Experiences

Note:

The generic goals and practices are originated from CMMI-DEV (Version 1.3). Kindly refer to the following hyperlink for more details regarding the generic goals and practices:

https://resources.sei.cmu.edu/asset_files/TechnicalReport/2010_005_001_15287.pdf

4.0 The Model Improvement Representation

The following capability levels are used to indicate the ability to conduct change management in the model:

Capability Level	Generic Goals	Specific Goals
CL0 (Incomplete)	No GG's are completed	SG's are partially completed or absent
CL1 (Performed)	GG1 is completed	SG1 - SG12 are completed
CL2 (Managed)	GG1 & GG2 are completed	SG1 - SG12 are completed
CL3 (Defined)	GG1, GG2 & GG3 are completed	SG1 - SG12 are completed

The following statements clarifies how the change management capability would vary from one capability level to the other within the organisation:

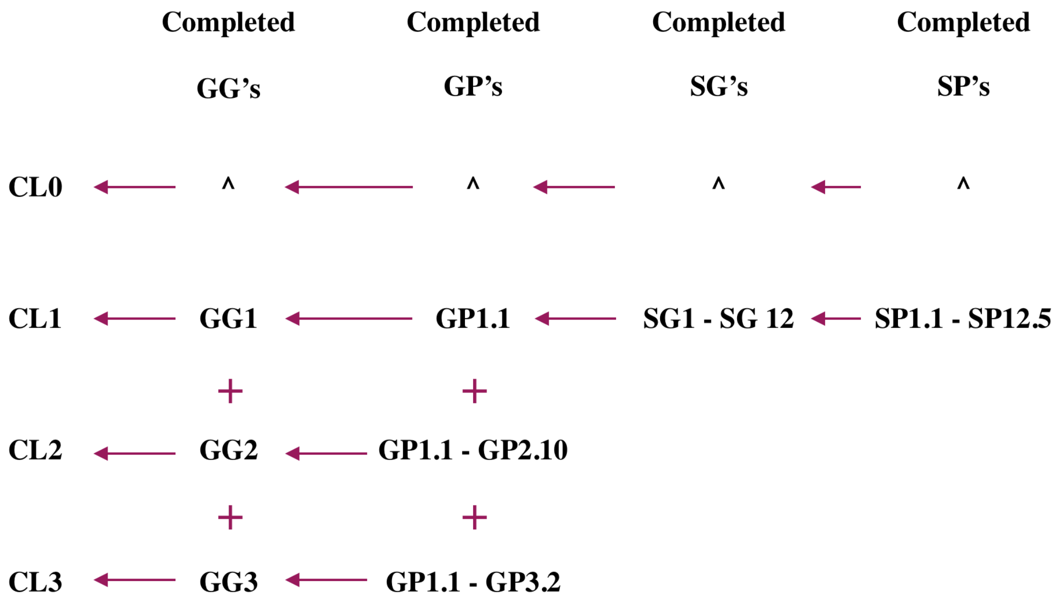
CL0 (Incomplete): Change management at this level is either partially or fully not performed with one or more specific goals not satisfied due to missing specific practices.

CL1 (Performed): Change management at this level is complete with all specific goals and the first generic goal satisfied. This level illustrates that a functioning change management process is established yet not maintained. In other words, the process aspects can be lost over time in case they are not standardised.

CL2 (Managed): Change management at this level is planned, monitored and evaluated, controlled, executed and reviewed according to an organisational policy. The process is also managed by competent personnel, has dedicated resources and involves all relevant stakeholders. This level requires the fulfilment of the second generic goal in addition to the first generic goal.

CL3 (Defined): Change management at this level is tailored from organisational standards to accommodate different project characteristics and parameters. The organisation's process tailoring guidelines should be continuously maintained and updated to fit the projects' needs. Information about the process conduct and deliverables are collected and analysed for continuous improvement. This level requires the fulfilment of the third generic goal in addition to the second and first generic goals.

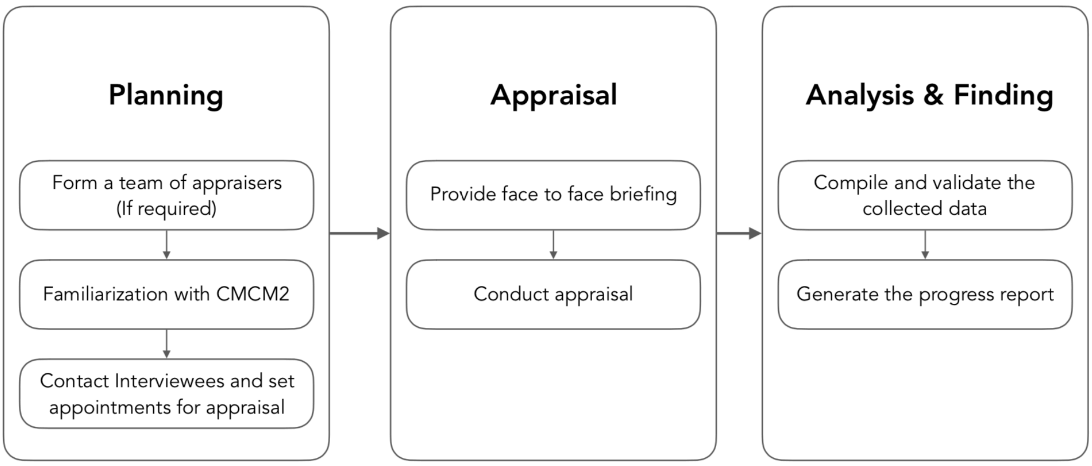
The following figure shows how all the goals and practices are connected to the each capability level:



^ Partially or fully incomplete practice and/or goal.

5.0 The Appraisal Cycle

The following figure shows an overview of the appraisal cycle used in CMCMM.



A) Planning:

The planning phase starts with forming a team of appraisers (if possible) and familiarise this team properly with CMCMM's components and the appraisal process. This familiarisation could be through preparations sessions and/or workshops that would include understanding this user guide and ensuring the team's ability to conduct the appraisal properly and consistently. It is mandatory for the appraiser to be properly trained, mentored or coached prior to conducting the actual appraisal. This is to reduce the possibility of inconsistent usage of the model in addition to increasing the overall efficiency and effectiveness of the appraisal process. Next, it is essential to contact the party(s) that will be involved in the appraisal within the organisation. A suitable appointment should be agreed upon to avoid any rapid responses pushed by work load of the interviewee and gaining as accurate information as possible. Prior to the appointment, the appraiser should provide a briefing about CMCMM and the main objectives of the model and highlighting how beneficial it can be for improving the change management capability within the organisation. The method of appraisal is also shared in order to estimate a suitable timing for the interviewing process.

B) Appraisal:

This phase starts with a confirming the appraisal's objective and providing a brief introduction for change management and the utilisation of capability maturity models. The appraiser(s) also confirms the robustness of the model and that it built and customised based on the experience and knowledge or practitioners working in the Kuwaiti construction industry. Next, the appraisal checklist should be used through face-to-face structured interviews in order to understand which practices are done or not within the organisation. This tool mainly checks the fulfilment of the CMCMM specific and generic practices. The data should be collected by the appraiser(s) from multiple sources in order to avoid unreliable answers. If feasible, the data should be accompanied with objective evidence of compliance such as templates, records, meeting minutes, emails, … etc. Objective evidence provides a more accurate perspective of the current change management processes applied within the organisation. That would be in addition to increasing the possibility of constructive feedback from the appraiser in improving the used process. It is advisable that the appraiser would be external to the appraised unit to avoid any biases and organisational pressures in appraising the capability of the organisation to manage change.

C) Analysis and Finding

The last phase of the appraisal is initiated with the compilation and validation of the collected data in order to conclude the change management capability level of the appraised organisation. The data is validated through confirming if a practice is actually conducted in the organisation according to the views of multiple interviewees. If high discrepancies are detected in responses related to the same practice, further investigation and evidence collection must be done to ensure the completion of the practice. The appraisal report is automatically generated since it is linked to the appraisal checklist tool. The report will calculate the change management capability level, indicate which practices and goals were fulfilled and which were incomplete, calculate the completion percentage of the specific goals based on the weight of the completed specific practices and show an illustrative chart of the specific goals completion profile. Any additional comments and findings mentioned in the appraisal checklist will be automatically transferred to the appraisal report. Generating an action plan based on the existing process gaps and follow through with the action plan implementation should be done by the appraised organisation. The frequency of the appraisal is also determined by the organisation's dedication to improving it's capability to successfully manage change.

6.0 The Appraisal Checklist

Specific Goal	Specific Practice		Comments
SG1	SP1.1	Assign change management roles	
	SP1.2	Sponsor and support the culture of change	
	SP1.3	Dedicate change management training, resources and funding	
	SP1.4	Share knowledge and experience through change logs of previous projects and/or	
	SP1.5	Audit team's preparedness for change	
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing	
	SP2.2	Circulate awareness emails regarding change management	
	SP2.3	Share knowledge and experience through informal discussions	
	SP2.4	Share knowledge and experience through formal meetings	
	SP2.5	Encourage transparency and communication amongst team members	
SG3	SP3.1	Compare actual cost and quantities with approved BOQ	
	SP3.2	Compare actual quality with the contract requirements and specifications	
	SP3.3	Compare actual project progress with the project schedule	
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	
	SP3.5	Communicate when a change occurs (verbally and/or writing)	
	SP3.6	Use photos and/or videos for reporting the worksite related changes	
SG4	SP4.1	Use change prediction tools	
	SP4.2	Use a database to identify potential change(s)	
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	
SG5	SP5.1	Use value management to identify positive change(s)	
	SP5.2	Use Building Information Modeling (BIM) for change identification	
	SP5.3	Use standard forms and documentation in identifying change	
SG6	SP6.1	Use a change log	
	SP6.2	Use records management	
	SP6.3	Use earned value methods	
	SP6.4	Use root cause analysis	
	SP6.5	Use standard forms and documentation in evaluating change	
SG7	SP7.1	Use risk analysis to understand risk implications	
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)	
	SP7.3	Use productivity oriented analysis for design revisions	
	SP7.4	Use knowledge-based decision support system (KBDSS)	
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	
	SP8.3	Use scheduling software to evaluate schedule related changes	
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	
	SP9.2	Use phones, messages and emails to provide updates about the change	
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	
	SP9.4	Gain formal client approval prior to change implementation	
	SP9.5	Implement minor changes that would not affect project parameters and requirements	
SG10	SP10.1	Use a change log	
	SP10.2	Use a content management system (CMS) for communication	
	SP10.3	Use Building Information Modeling (BIM)	
	SP10.4	Use standard forms and documentation for implementing and monitoring change	
SG11	SP11.1	Share experiences through informal discussions	
	SP11.2	Encourage professional development related to change management	
	SP11.3	Encourage self-driven knowledge and skills enhancement	
SG12	SP12.1	Benchmark the process outcomes	
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	
	SP12.3	Share experiences through project close out meeting	
	SP12.4	Use, update and maintain a change log	
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	

Promoting a balanced change culture
Identifying Change
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Generic Goal	Generic Practice	Comments
GG1 Achieve Specific Goals	GP 1.1 Perform Specific Practices	
GG 2 Institutionalize a Managed Process	GP 2.1 Establish an Organizational Policy	
	GP 2.2 Plan the Process	
	GP 2.3 Provide Resources	
	GP 2.4 Assign Responsibility	
	GP 2.5 Train People	
	GP 2.6 Control work products	
	GP 2.7 Identify and Involve Relevant Stakeholders	
	GP 2.8 Monitor and control the process	
	GP 2.9 Objectively Evaluate Adherence	
	GP 2.10 Review Status with Higher Level Management	
GG 3 Institutionalize a Defined Process	GP 3.1 Establish a Defined Process	
	GP 3.2 Collect Process Related Experiences	

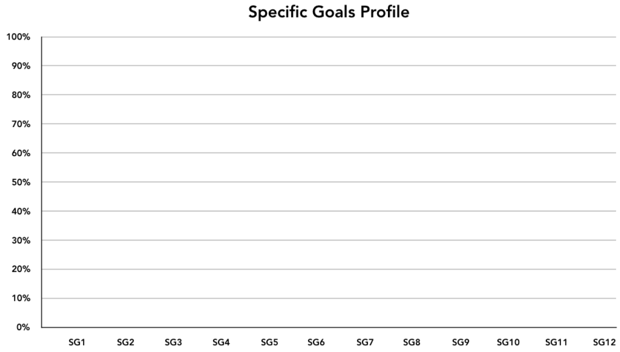
Appraiser(s) Initials:

Appraisal Date:

7.0 The Appraisal Report

Capability Level	0

		Progress
Specific Goals	SG1	0%
	SG2	0%
	SG3	0%
	SG4	0%
	SG5	0%
	SG6	0%
	SG7	0%
	SG8	0%
	SG9	0%
	SG10	0%
	SG11	0%
	SG12	0%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived



Specific / Generic Practice		Comments
SP1.1	Assign change management roles	
SP1.2	Sponsor and support the culture of change	
SP1.3	Dedicate change management training, resources and funding	
SP1.4	Share knowledge and experience through change logs of previous projects and/or shared databases	
SP1.5	Audit team's preparedness for change	
SP1.6	Use standard forms and documentation in promoting a balanced change culture	
SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing the contract	
SP2.2	Circulate awareness emails regarding change management	
SP2.3	Share knowledge and experience through informal discussions	
SP2.4	Share knowledge and experience through formal meetings	
SP2.5	Encourage transparency and communication amongst team members	
SP3.1	Compare actual cost and quantities with approved BOQ	
SP3.2	Compare actual quality with the contract requirements and specifications	
SP3.3	Compare actual project progress with the project schedule	
SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	
SP3.5	Communicate when a change occurs (verbally and/or writing)	
SP3.6	Use photos and/or videos for reporting the worksite related changes	
SP4.1	Use change prediction tools	
SP4.2	Use a database to identify potential change(s)	
SP4.3	Use root cause analysis to understand the main trigger(s) of the change	
SP5.1	Use value management to identify positive change(s)	
SP5.2	Use Building Information Modeling (BIM) for change identification	
SP5.3	Use standard forms and documentation in identifying change	

SP6.1	Use a change log
SP6.2	Use records management
SP6.3	Use earned value methods
SP6.4	Use root cause analysis
SP6.5	Use standard forms and documentation in evaluating change
SP7.1	Use risk analysis to understand risk implications
SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)
SP7.3	Use productivity oriented analysis for design revisions
SP7.4	Use knowledge-based decision support system (KBDSS)
SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed
SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes
SP8.3	Use scheduling software to evaluate schedule related changes
SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis
SP9.2	Use phones, messages and emails to provide updates about the change
SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change
SP9.4	Gain formal client approval prior to change implementation
SP9.5	Implement minor changes that would not affect project parameters and requirements without client approval
SP10.1	Use a change log
SP10.2	Use a content management system (CMS) for communication
SP10.3	Use Building Information Modeling (BIM)
SP10.4	Use standard forms and documentation for implementing and monitoring change
SP11.1	Share experiences through informal discussions
SP11.2	Encourage professional development related to change management
SP11.3	Encourage self-driven knowledge and skills enhancement
SP12.1	Benchmark the process outcomes
SP12.2	Use a content management system (CMS) for storing and sharing lesson learned
SP12.3	Share experiences through project close out meeting
SP12.4	Use, update and maintain a change log
SP12.5	Use standard forms and documentation in continuously improving from lessons learned
GP 1.1	Perform Specific Practices
GP 2.1	Establish an Organizational Policy
GP 2.2	Plan the Process
GP 2.3	Provide Resources
GP 2.4	Assign Responsibility
GP 2.5	Train People
GP 2.6	Control work products
GP 2.7	Identify and Involve Relevant Stakeholders
GP 2.8	Monitor and control the process
GP 2.9	Objectively Evaluate Adherence
GP 2.10	Review Status with Higher Level Management
GP 3.1	Establish a Defined Process
GP 3.2	Collect Process Related Experiences

8.0 CMCMM Example

The following scenario is shown for the purpose of clarifying how the CMCMM components operates only and is not based on a real organisation.

Scenario (Company X):

Company X is based in Kuwait and is continuously suffering from cost overruns in some of its projects due to improperly managed project changes. The company has procured an expert for consultation on the current situation and possible solutions of the faced challenge. The expert gained approval from the relevant stakeholders to use the Change Management Capability Maturity Model (CMCMM) in order to find the weaknesses in the process and advise on potential solutions of the current situation. The expert also gained approval for accessing documentation as evidence for compliance with the model criteria.

A team of appraisers was formed and properly brief to the usage of CMCMM. Appointments were scheduled and the appraisal was then conducted with multiple project managers working Company X and the data was collected from three project managers. When the data was collected, few discrepancies in the responses were detected. To clarify the situation, the appraisal team requested evidence of conducting the specific practices SP3.1, SP4.2 and SP10.4. No substantial objective evidence of the SP's fulfilment was provided therefore these practices were considered missing from change management process used by the contracting company. The report was then automatically generated (since it is connected with the appraisal checklist) showing the necessary information that clarifies the current state of change management capability. Clearly, there are missing specific practices in the organisation which resulted in a Capability Level 0 thus indicating an incomplete process. Since the specific goals were not completely achieved, there was no use to continue the appraisal and check the generic goals as this will not result in any increase in the concluded capability level without completing the specific goals first. Finally, the report was passed by to the point of contact in the company for creating an action plan and following through with implementing improvements.

Specific Goal		Specific Practice		Comments
SG1	SP1.1	Assign change management roles	✓	
	SP1.2	Sponsor and support the culture of change		
	SP1.3	Dedicate change management training, resources and funding	✓	
	SP1.4	Share knowledge and experience through change logs of previous projects and/or	✓	
	SP1.5	Audit team's preparedness for change	✓	
	SP1.6	Use standard forms and documentation in promoting a balanced change culture		
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing	✓	
	SP2.2	Circulate awareness emails		
	SP2.3	Share knowledge and experience through informal discussions	✓	
	SP2.4	Share knowledge and experience through formal meetings		
	SP2.5	Encourage transparency and communication amongst team members		
SG3	SP3.1	Compare actual cost and quantities with approved BOQ		
	SP3.2	Compare actual quality with the contract requirements and specifications	✓	
	SP3.3	Compare actual project progress with the project schedule		
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	✓	
	SP3.5	Communicate when a change occurs (verbally and/or writing)		
	SP3.6	Use photos and/or videos for reporting the worksite related changes	✓	
SG4	SP4.1	Use change prediction tools		
	SP4.2	Use a database to identify potential change(s)		
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	✓	
SG5	SP5.1	Use value management to identify positive change(s)	✓	
	SP5.2	Use Building Information Modeling (BIM) for change identification		
	SP5.3	Use standard forms and documentation in identifying change		
SG6	SP6.1	Use a change log	✓	
	SP6.2	Use records management		
	SP6.3	Use earned value methods	✓	
	SP6.4	Use root cause analysis	✓	
	SP6.5	Use standard forms and documentation in evaluating change		
SG7	SP7.1	Use risk analysis to understand risk implications	✓	
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)		
	SP7.3	Use productivity oriented analysis for design revisions		
	SP7.4	Use knowledge-based decision support system (KBDSS)		
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	✓	
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes		
	SP8.3	Use scheduling software to evaluate schedule related changes	✓	
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis		
	SP9.2	Use phones, messages and emails to provide updates about the change	✓	
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	✓	
	SP9.4	Gain formal client approval prior to change implementation		
	SP9.5	Implement minor changes that would not affect project parameters and requirements		
SG10	SP10.1	Use a change log	✓	
	SP10.2	Use a content management system (CMS) for communication	✓	
	SP10.3	Use Building Information Modeling (BIM)		
	SP10.4	Use standard forms and documentation for implementing and monitoring change		
SG11	SP11.1	Share experiences through informal discussions	✓	
	SP11.2	Encourage professional development related to change management		
	SP11.3	Encourage self-driven knowledge and skills enhancement		
SG12	SP12.1	Benchmark the process outcomes	✓	
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	✓	
	SP12.3	Share experiences through project close out meeting	✓	
	SP12.4	Use, update and maintain a change log		
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	✓	

Promoting a balanced change culture

Identifying Change

Evaluating Change

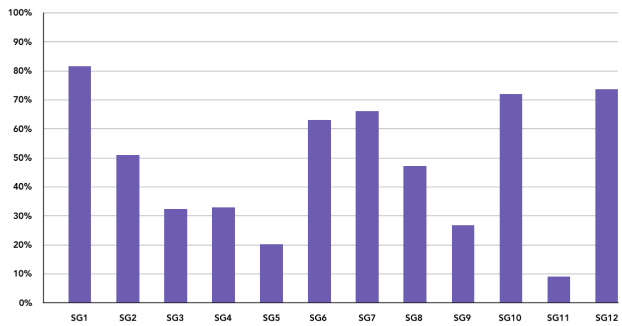
Implementing and Monitoring Change

Continuos Improvement

Capability Level	0

		Progress
Specific Goals	SG1	82%
	SG2	51%
	SG3	32%
	SG4	33%
	SG5	20%
	SG6	63%
	SG7	66%
	SG8	47%
	SG9	27%
	SG10	72%
	SG11	9%
	SG12	74%
Generic Goals	GG1	Not Acheived
	GG2	Not Acheived
	GG3	Not Acheived

Specific Goals Profile



Appraisers Comments

Evidence of the availability of SP3.1, SP4.2 and SP10.4 was requested and none was available. Therefore these three practices will be considered absent in the appraisal checklist and subsequently the appraisal report.

Specific Goal	Specific Practice		
SG1	SP1.1	Assign change management roles	☑
	SP1.2	Sponsor and support the culture of change	☐
	SP1.3	Dedicate change management training, resources and funding	☑
	SP1.4	Share knowledge and experience through change logs of previous projects and/or	☑
	SP1.5	Audit team's preparedness for change	☑
	SP1.6	Use standard forms and documentation in promoting a balanced change culture	☐
SG2	SP2.1	Review the feasibility of the project requirements and variation clauses prior to signing	☑
	SP2.2	Circulate awareness emails	☐
	SP2.3	Share knowledge and experience through informal discussions	☑
	SP2.4	Share knowledge and experience through formal meetings	☐
	SP2.5	Encourage transparency and communication amongst team members	☐
SG3	SP3.1	Compare actual cost and quantities with approved BOQ	☐
	SP3.2	Compare actual quality with the contract requirements and specifications	☑
	SP3.3	Compare actual project progress with the project schedule	☐
	SP3.4	Use Microsoft Word and/or Microsoft Excel for describing the change cause(s)	☑
	SP3.5	Communicate when a change occurs (verbally and/or writing)	☐
	SP3.6	Use photos and/or videos for reporting the worksite related changes	☑
SG4	SP4.1	Use change prediction tools	☐
	SP4.2	Use a database to identify potential change(s)	☐
	SP4.3	Use root cause analysis to understand the main trigger(s) of the change	☑
SG5	SP5.1	Use value management to identify positive change(s)	☑
	SP5.2	Use Building Information Modeling (BIM) for change identification	☐
	SP5.3	Use standard forms and documentation in identifying change	☐
SG6	SP6.1	Use a change log	☑
	SP6.2	Use records management	☐
	SP6.3	Use earned value methods	☑
	SP6.4	Use root cause analysis	☑
	SP6.5	Use standard forms and documentation in evaluating change	☐
SG7	SP7.1	Use risk analysis to understand risk implications	☑
	SP7.2	Use change predicting system using activity-based dependency structure matrix (DSM)	☐
	SP7.3	Use productivity oriented analysis for design revisions	☐
	SP7.4	Use knowledge-based decision support system (KBDSS)	☐
SG8	SP8.1	Request the experts of the subcontractor, supplier or the design consultant if needed	☑
	SP8.2	Use Microsoft Excel to evaluate quantity and/or cost changes	☐
	SP8.3	Use scheduling software to evaluate schedule related changes	☑
SG9	SP9.1	Monitor implemented change and report on a daily, weekly or monthly basis	☐
	SP9.2	Use phones, messages and emails to provide updates about the change	☑
	SP9.3	Use Microsoft Word and/or Microsoft Excel to monitor change	☑
	SP9.4	Gain formal client approval prior to change implementation	☐
	SP9.5	Implement minor changes that would not affect project parameters and requirements	☐
SG10	SP10.1	Use a change log	☑
	SP10.2	Use a content management system (CMS) for communication	☑
	SP10.3	Use Building Information Modeling (BIM)	☐
	SP10.4	Use standard forms and documentation for implementing and monitoring change	☐
SG11	SP11.1	Share experiences through informal discussions	☑
	SP11.2	Encourage professional development related to change management	☐
	SP11.3	Encourage self-driven knowledge and skills enhancement	☐
SG12	SP12.1	Benchmark the process outcomes	☑
	SP12.2	Use a content management system (CMS) for storing and sharing lesson learned	☑
	SP12.3	Share experiences through project close out meeting	☑
	SP12.4	Use, update and maintain a change log	☐
	SP12.5	Use standard forms and documentation in continuously improving from lessons learned	☑